



09/08/03

INTERMOUNTAIN POWER SERVICE CORP.

JOHN R. LARSEN

850 West Brush Wellman Rd.

Delta, UT 84624

Tel: 435 864 6537

Fax: 435 864 6678

E-Mail: john-l@ipsc.com

Subject: Proposal for 10,000 Hp ID Fan Medium Voltage Frequency Drive Systems

Your ref.: RFQ - 45605

Our ref.: HK01-1315 / ATDA

Dear Mr. Larsen

Please receive the proposal for subject project. In the spirit of this retrofit project we are strictly proposing our standard LCI solution with standard options in compliance with the project performance requirements.

ABB is proposing the replacement of the existing dual channel LCI converter including DC reactors and output contactors by a new standard ABB 12 pulse / 12 pulse Air cooled LCI converter. This new converter will have the same performance behavior as the existing converter, regarding impact to the line, the motor, losses, etc., and as such the implementation risk regarding technical and schedule will be absolutely minimal. The mechanical dimensions of the converter increase the door width, so the door would need to be temporarily increased. If this is possible, this solution supports the low risk approach to deliver the standard converter design with less engineering effort and on site assembly. Per drive, one piece, completely wired and factory tested can be moved in place, connected and commissioned.

In case the door width can not be modified with reasonable effort, we have included an alternate proposal with the same LCI converter, but with a shipping-split. The performance of this alternate converter is the same as the base proposal.

A budgetary cost is provided for the power factor correction / harmonic filter, since this option would be executed upon power increase of the fan only. One filter for two LCI drives would be connected to 6.9 kV bus.

Spare parts, are quoted as well as site service rates and optional site training.

The prices for the Phases 2, 3 and 4 are based on a price escalation formula, considering material and labor indices.

ABB Inc.

Large AC Drives Division
16250 W. Glendale Drive, New Berlin, WI 53151
P O Box 372, Milwaukee, WI 53201-0372

Telephone
(262) 785-3200

Telefax.
(262) 785-8628

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The proposal also includes preliminary plant arrangement sketches. The final location of the converters can be decided upon review of the cable connection location and room internal access. One sketch shows the first drive replaced, the other shows all four drives replaced.

The proposal includes several attachments as follows.

Part C, 15 pages	TAB 2
Comments to T&C	TAB 3
Proposal Technical Part	TAB 4
Balance of Attachments	TAB 5

We are looking forward to discuss this proposal with you. Please contact us at your convenience.

Best regards,
ABB Inc.

A handwritten signature in black ink, appearing to read 'H. Krattiger'.

Hansueli Krattiger
Mgr. Large AC Drives

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CONDITIONS

Subject	Proposal for 10,000 Hp LCI Converters
Intended for	ID Fan
Prices (in US\$)	see price sheet
Tender valid until	October 6, 2003
Packing	included
Freight	DDP site, Delta, UT
Insurance	not included
Customs Duties	included
Taxes	not included
Erection	not included
Commissioning	rates quoted
Delivery	1st unit latest February 20, 2004, considering receipt of receipt of technically and commercially agreed purchase order no later than September 26, 2003
Terms of payment	net 30 days 1/3 with order 1/3 at half delivery time 1/3 at delivery, but no later than 3 months after notification that the goods are ready for dispatch

Our General Conditions of Supply attached hereto form an integral part of this tender. They are binding in all respects unless otherwise expressly agreed upon in writing. Special conditions of the purchaser which are contrary to these General Conditions of Supply are valid only if accepted in writing by ourselves.

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PRICE SHEET

1. Phase 1 for delivery February 20, 2004, Base Proposal for
qty. (1) Converter, item 100, DDP Delta, UT \$ 763,165.00
2. Phase 1 for delivery February 20, 2004, Alternate Proposal for
qty. (1) Converter, item 110, DDP Delta, UT \$ 824,924.00
3. Phase 2 for delivery January 31, 2005, Base Proposal for
qty. (2) Converters, item 100, DDP Delta, UT \$ 1,400,607.00
Escalation Formula applies
4. Phase 2 for delivery January 31, 2005, Alternate Proposal for
qty. (2) Converters, item 110, DDP Delta, UT \$ 1,543,976.00
Escalation Formula applies
5. Phase 3 for delivery January 31, 2006, Base Proposal for
qty. (3) Converters, item 100, DDP Delta, UT \$ 2,100,910.00
Escalation Formula applies
6. Phase 3 for delivery January 31, 2006, Alternate Proposal for
qty. (3) Converters, item 110, DDP Delta, UT \$ 2,315,964.00
Escalation Formula applies
7. Phase 4 for delivery January 31, 2007, Base Proposal for
qty. (2) Converters, item 100, DDP Delta, UT \$ 1,400,607.00
Escalation Formula applies
8. Phase 4 for delivery January 31, 2007, Alternate Proposal for
qty. (2) Converters, item 110, DDP Delta, UT \$ 1,543,976.00
Escalation Formula applies
9. Qty. of (4) 6.5 MVA power factor correction / harmonics filters,
item 200, DDP Delta, UT, budgetary estimate \$ 700,000.00
We assume this item will be ordered upon ID Fan power increase.
Budgetary estimate, Escalation Formula applies
10. Spare parts package adder, per item 300, CIF Jeannette PA..... \$ 66,170.00
Escalation Formula applies if not ordered at the same time as Phase 1 equipment
11. Site Services, item 400 According to rates sheet
Labor only Escalation Formula applies $P = P_o \cdot (L_m / L_o) / (E / E_o)$

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12. Training optional adder, item 500..... \$ 9,500.00

Price Escalation Formula

Prices for items indicated will be adjusted according to the following escalation formula at the time of notice to proceed for this phase.

$$P = Po * (0.10 + 0.70 * (Lm / Lo) + 0.20 * (Mm / Mo)) / (E / Eo)$$

P = Price per phase

Po = Total price offered per phase or item

Lm = Index of wages as per ASM (Swiss Employers Association of Machine Industries) valid at the date (quarter) of order.

Lo = 113.69 (1995=100) Index of wages as per ASM valid of the date (quarter) of this tender.

Mm = Index "DJ" for Metals and Metal-Products as per BSF (Swiss Federal Statistical Office) valid at the date of this tender.

Mo = 100 (May03=100) Index of Metals and Metal-Products as per BSF (Swiss Federal Statistical Office) valid at the date of this tender.

E = Spot Exchange Rate USD/CHF valid at the date of order. According to <http://www.bloomberg.com/markets/currencies/eurafrcurrencies.html>, taken at 10 AM EST.

Eo = 1.418 Spot Exchange Rate USD/CHF used in this tender.



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COMMENTS TO THE SPECIFICATION - TECHNICAL

In general, if not otherwise commented, the ABB standards for documentation, quality system, manufacturing and testing of the product apply.

PART C – DIVISION C3 Supplementary Information

Torsional Analysis documentation:

The Torsional analysis, for retrofitting the existing 12-pulse LCI converter with the new ABB 12/12-pulse LCI converter is not included and not required, since the torque pulsations produced by the retrofitted LCI drive is the same in both drives due to their power and configuration. Our recommendation is to perform this analysis when upgrading the system to 10'000hp. We can provide this analysis against a separate quotation.

Maintenance of the drive per attached document "Installation Procedure"

Adequate Storage conditions per attached document "Installation Procedure"

The LCI converter has typically following calculated values. See also the paper on Availability in attachment:

Availability:	0.99992
MTBF:	50'000 hours
MTTR:	2..4 hours

Speed below 10% nominal is described in the MEGADRIVE LCI-System Description.

Bearing Wear due to Common Modes: No issue, as existing motor is designed for LCI operation and needs to have insulated bearings on the motor.

Insulation Breakdown of the End Turns of the Motor Winding: We do not see this as an issue as the existing motor is designed for LCI operation.

PART C - DIVISION C3

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C3-2,C3-3 ABB will provide the product according to its standard documentation for LCI.DR. See "Document List" in attachment.

PART F - DIVISION F2

F2-1 §1/F2-3 §5a. The existing output contactors are not required in our standard LCI design. The design is a series connected 12/12 pulse system, not requiring output isolation between the two 6 pulse outputs. In case of maintenance grounding the equipment according to maintenance procedure is required.

F2-1 §3. Existing Equipment removal, installation and cabling of new equipment is not quoted. Commissioning rates can be seen in attached rates sheet.

F2-3§5.b. The harmonic filters are on a budgetary basis and will be defined in detail during the power upgrade.

F2-3§5.d Converter will be factory tested according to ABB standard procedures.

F2-4§6a-g ABB is not providing any miscellaneous materials and services as it is not part of the standard offerings. ABB will provide services for commissioning according to attached rates sheet.

F2-9§15. For Phase 1, the first unit, the Kick-off meeting date at customer must be 5 days after award of contract latest, in order to respect the tight delivery schedule.

PART F - DIVISION F4

F3-3§13 Cabinet interior painting is according to our standard (no inside painting for EMC reasons)

PART F - DIVISION F7

F7-1§1. LCI Ambient temperature +1 to 50°C



F7-3§2. It is only valid when filter unit is installed. First delivery covers LCI converters only with budgetary proposal for Filters.

F7-4§c(3) For retrofit with existing transformers, 12-pulse LCI converters are required. Harmonic filtering is quoted to meet IEEE requirements.

F7-5§5 Not included in our standard LCI, and not required.

F7-6§d It is not possible to drive with one winding in service.

F7-7§2d For existing installation no torsional analysis will be provided as new LCI has same waveforms and 12/12 topology existing design. For the power upgrade a new Torsional analysis is recommended.

F7-8§2f It is only valid when filter unit is installed. First delivery covers LCI converters only with budgetary proposal for Filters.

F7-9§2g ABB standard covers an input voltage drop to 85% of rated Voltage, below if the voltage drops below 85%, the converter current will be immediately reduced to zero and the motor will coast down; indication: alarm "line undervoltage". If the voltage recovers within defined time, e.g. 1 sec above 85%, the converter current will be built up again (flying start) and the motor will re-accelerate to the speed set value. Such a voltage-dip ride through is however only possible if the control electronic has an un-interruptible power supply. If the voltage stays below 85% for longer than defined time, e.g. 1 sec, the converter will be tripped and the motor will continue to coast down; indication: trip "line undervoltage".

F7-11§4b This is not required; ABB standard builds upon an experience of over 30 years for LCI's. Our standard for ID fan application is single channel.

F7-12§4d Revert to *F7-9§2g*

F7-12§4g Ground fault generates a trip

F7-13§5f MTTR for thyristor exchange 1..2 hours



F7-13§6a ABB Standard for LCI Ambient temperature +1 to 50°C

F7-13§6c We do not require redundancy; further this is not part of our product standard.

F7-13§6e Cabinets and doors according to ABB Standard see technical specification. Air-filters cannot be exchanged during operation because doors must be opened.

F7-16§7. Consult our ABB Standard, for Protective device and diagnostics in technical specification. In particular, no fault logger, historic log and laptops printer provided.

F7-23§11. Converter Testing is according to ABB standards. The converter routine tests follow IEC60146.



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COMMENTS TO THE SPECIFICATION - COMMERCIAL

PART C - DIVISION C1

Bond/Check. We have provided the \$ 50,000 check as required. The check will be returned to ABB if (a) ABB is the successful bidder, and the mutually agreed contract is signed by both parties, or (b) if ABB is not the successful bidder upon entering an agreement with the successful bidder or upon exceeding the ABB proposal validity date.

PART E, F - DIVISION E1, E2 and F1

See the separate word document of specification divisions E1, E2 and F1 with our comments inserted in color.



EXCLUSIONS FROM SCOPE OF SUPPLY

In general, items that are not explicitly mentioned are not included in our offer. However, we would particularly draw your attention to the following:

- Incoming circuit breaker and its protection / control (existing)
- Input transformer (existing)
- Motor, motor monitoring and protection (existing)
- Cables, cabling between circuit breaker, transformer, motor and drive
- Foundation and installation work
- HVAC Cooling system
- Remote and superimposed process control systems
- Specific customer documentation requirements (if different to ABB / IEC standard)
- Specific customer marking/labeling requirements (if different to ABB / IEC standard)
- Customer witness tests*
- Combined test at ABB ("back to back" or "load test")*
- Installation and installation supervision
- Performance tests at site

* Can be quoted separately as an option



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SCOPE OF SUPPLY

Item	Qty.	Description
100	1	<p>Frequency converter LCI-type (ABB) mounted on common base frame</p> <p>Type A1212-404R452</p> <p>See technical part below for details.</p> <p>This ABB standard LCI air cooled converter replaces the existing dual channel LCI converter including output contactors and DC Link reactors. The converter exceeds the size limit given by the access door. However, if the door can be removed for access, this design is best to implement at site with low technical and schedule risk.</p> <p>The DC link reactor is part of converter line up.</p> <p>The converter to be placed at best location relative to existing cables. See preliminary plant location diagram attached.</p>
110	1	<p>Alternate Frequency converter LCI-type (ABB) split design with two separate shipping pieces assembled at site</p> <p>Type A1212-404R452</p> <p>Identical to item 110 except as noted.</p> <p>See technical part below for details.</p> <p>This ABB standard LCI air cooled converter replaces the existing dual channel LCI converter including output contactors and DC Link reactors. The converter shipping pieces fit through the access door. Two smaller DC link reactors are used to balance the two shipping pieces.</p> <p>The DC link reactors are part of converter line up.</p> <p>The converter to be placed at best location relative to existing cables. See preliminary plant location diagram attached.</p>



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Item	Qty.	Description
200	1	<p>Power Factor Correction Filter (Preliminary and Budgetary)</p> <p>See technical part for details. Many options are possible for the filter configuration, and detail data are not available at this time. We assume the filters would be installed upon execution of power increase to 10,000 Hp.</p>
300	1	<p>Spare Parts</p> <p>Converter: One of each printed circuit boards, one power electronic element , MCBs. See detailed list in attachment.</p> <p>One set of spares will cover all eight identical drives.</p>
400		<p>Site Services</p> <p>Commissioning of this LCI Converter can be performed within 3-5 working days for one commissioning engineer, depending on the preconditions and availability of the HV power and gear / load for load tests. The rates for ABB service engineers are shown in the enclosed rates sheet.</p> <p>Expenses are per rates sheet. Note, commissioning is normally being performed by ABB commissioning engineers located throughout the US.</p>
500	1	<p>Optional Training</p> <p>Four days operation, maintenance and troubleshooting training at site, per attached training outline. The training at site includes teacher, preparation, and material. Traveling time and living expenses are extra, according to enclosed rates sheet. The training can be provided by the commissioning engineer during commissioning phase.</p>



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ATTACHMENTS

1. Part C, 15 pages	TAB 2
2. Comments to T&C	TAB 3
3. Proposal Technical Part	TAB 4
4. LCI System Description	TAB 5
5. Plant Layout Drawings	
6. Preliminary Schedule	
7. Preliminary Harmonic Analysis	
8. Spare Parts	
9. Labor rates sheet	
10. Commissioning Procedure	
11. Installation Procedure	
12. Factory Testing	
13. Documents List	
14. Training outline	
15. Reference List	
16. References - Contacts	
17. Availability Paper	
18. LCI Brochure	
19. PSR Brochure	

THE FACE OF THIS DOCUMENT HAS A MULTI-TONE BACKGROUND ON WHITE PAPER

JPMorgan Chase Bank
Buffalo, NY 14202



10-94
220

0217224688

Date: SEPTEMBER 08 03

OFFICIAL CHECK

Pay to the
order of INTERMOUNTAIN POWER AGENCY IPA

\$ ****50,000.00

Amount \$*****50,000 AND 00 CENTS

U.S. Dollars

ABB INC.

323948286

N/A

[Signature]
Authorized Signature
[Signature]

THE BACK OF THIS DOCUMENT CONTAINS AN ARTIFICIAL WATERMARK - HOLD AT AN ANGLE TO VIEW

⑈0217224688⑈ ⑆022000842⑆601600026⑈

02 3891 (10-01)

PART C - DIVISION C1**BIDDING DOCUMENTS****BIDDER'S BOND**

(Not necessary when certified or cashier's check accompanies bid. See below*.)

SURETY BOND

We, the undersigned Principal and Surety, acknowledge ourselves jointly and severally bound to Intermountain Power Agency (IPA) and Intermountain Power Service Corporation (IPSC) of the state of Utah, and the City of Los Angeles Department of Water and Power (LADWP), in the sum of _____ Dollars (\$ _____), to be paid to IPA if the attached Proposal shall be accepted and the proposed Contract awarded to said bidder, and said bidder shall fail to execute the Contract and Bond for the faithful performance thereof; otherwise this obligation to be void.

Dated: _____ 20____

Firm Name: _____

By: _____
(Signature)**

(Surety): _____

By: _____
(Signature)

*When the bidder is submitting a check in lieu of a Bond, the check must be made payable to Intermountain Power Agency, must either be certified by a responsible bank or be a cashier's check issued by a responsible bank, and must be payable in the state of Utah.

If check is submitted herewith, state check number 0217224688 and amount \$ 50,000

**See Form, Signature, and Delivery of the Proposals, Division B1

NOTE: All signatures above must be written in ink.

PROPOSAL

The undersigned hereby proposes to furnish and deliver **up to eight (8) Induced Draft Fan Medium Voltage Variable Frequency Drive Systems** to the Intermountain Power Service Corporation in accordance with **Specifications 45605**.

The undersigned agrees, upon the acceptance of this Proposal: (a) To execute IPSC's form of Contract (including the Contract Agreement and other Contract Documents identified in said Specifications) for furnishing and delivering the items and services embraced in the accepted Proposal; and (b) To perform its obligations under the Contract at the prices stated in the accompanying Proposal Schedule.

The undersigned furthermore agrees that, in case of failure to execute such Contract Agreement and provide the necessary check or Bidder's Bond accompanying this Proposal, and the monies payable thereon, shall be forfeited to and remain the property of Intermountain Power Agency.

The undersigned declares under penalty of perjury that this Proposal is genuine, is not a sham or collusive, and is not made in the interest or in behalf of any person or entity not herein named. The undersigned further declares under penalty of perjury that the bidder has not directly or indirectly induced or solicited any other bidder to submit a sham bid, or any other person, firm, or corporation to refrain from bidding. The undersigned also declares under penalty of perjury that the bidder has not in any manner sought by collusion to secure for itself an advantage over any other bidder.

I declare under penalty of perjury under the laws of the state of Utah that the foregoing is true and correct.

Date: September 8, 2008

Bidder: ABB Inc.

Address: 16250 W. Glandale Dr.
New Berlin, WI 53151

Signed By: Hansueli Krattiger
(Authorized Signature)

Print Name: Hansueli Krattiger

Title: Mgr. ABB Large AC Drives

"Base Proposal"

Spec. 45605

PART C- DIVISION C2

BIDDING DOCUMENTS - PROPOSAL SCHEDULE

Proposal is hereby made to furnish and deliver to IPSC up to eight (8) Induced Draft Fan Medium Voltage Variable Frequency Drive Systems, F.O.B., IPP Plant Site, 850 West Brush Wellman Road, Delta, UT 84624, in accordance with Specifications 45605, the following:

Lump Sum Price For One (1) Complete Drive System For One (1) ID Fan Delivered In January 2004	
Price in Words: _____	Price in Dollars: \$ <u>763,165</u>
Lump Sum Price For Two (2) Complete Drive Systems For Two (2) ID Fans Delivered In January 2005	
Price in Words: _____	Price in Dollars: \$ <u>1,400,607</u>
Lump Sum Price For Three (3) Complete Drive Systems For Three (3) ID Fans Delivered In January 2006	
Price in Words: _____	Price in Dollars: \$ <u>2,100,910</u>
Lump Sum Price For Two (2) Complete Drive Systems For Two (2) ID Fans Delivered In January 2007	
Price in Words: _____	Price in Dollars: \$ <u>1,400,607</u>
Latest Date for IPSC To Exercise Option To Purchase Two (2) Complete Drive Systems In January 2005	
Date: <u>5/10/2004</u>	
Latest Date For IPSC To Exercise Option To Purchase Three (3) Complete Drive Systems In January 2006	
Date: <u>5/9/2005</u>	
Latest Date For IPSC To Exercise Option To Purchase Two (2) Complete Drive Systems in January 2007	
Date: <u>5/15/2006</u>	

****Note: Bids shall include an anticipated payment schedule.**

"Alternate Proposal"

Spec. 45605

PART C- DIVISION C2

BIDDING DOCUMENTS - PROPOSAL SCHEDULE

Proposal is hereby made to furnish and deliver to IPSC up to eight (8) Induced Draft Fan Medium Voltage Variable Frequency Drive Systems, F.O.B., IPP Plant Site, 850 West Brush Wellman Road, Delta, UT 84624, in accordance with Specifications 45605, the following:

Lump Sum Price For One (1) Complete Drive System For One (1) ID Fan Delivered In January 2004	
Price in Words: _____	Price in Dollars: \$ <u>824,924</u>
Lump Sum Price For Two (2) Complete Drive Systems For Two (2) ID Fans Delivered In January 2005	
Price in Words: _____	Price in Dollars: \$ <u>1,543,976</u>
Lump Sum Price For Three (3) Complete Drive Systems For Three (3) ID Fans Delivered In January 2006	
Price in Words: _____	Price in Dollars: \$ <u>2,315,964</u>
Lump Sum Price For Two (2) Complete Drive Systems For Two (2) ID Fans Delivered In January 2007	
Price in Words: _____	Price in Dollars: \$ <u>1,543,976</u>
Latest Date for IPSC To Exercise Option To Purchase Two (2) Complete Drive Systems In January 2005	
Date: <u>5/10/2004</u>	
Latest Date For IPSC To Exercise Option To Purchase Three (3) Complete Drive Systems In January 2006	
Date: <u>5/9/2005</u>	
Latest Date For IPSC To Exercise Option To Purchase Two (2) Complete Drive Systems in January 2007	
Date: <u>5/15/2006</u>	

****Note:** Bids shall include an anticipated payment schedule.

C2-1 - A

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DIVISION C2

PROPOSAL SCHEDULE

Contractor's Technical Services: The following adjuring prices will be used to adjust the Contract amount for manufacturer's service representatives time:

	Daily Rate	Daily Overtime Rate
Per Diem at the IPP Job Site:	See Rates	Sheet
Per Round Trip to and from the IPP Job Site:	See Rates	Sheet

Prices: The price or prices shall be firm.

Cash Terms: A discount for prompt payment is offered of 0 percent for Contract payments made within 30 calendar days after date of acceptance or delivery and receipt of invoice.
Note: Terms are 30 days net

Taxes: The foregoing quoted prices are exclusive of all applicable sales and use taxes.

Manufacturer: ABB

Location of Point of Manufacture: Baden, Switzerland

Brand and Catalog Number or Other Designation: LC1 DR A1212 - 404 R452

Form of Business Organization: The bidder shall state below the form of its business organization.

Bidder is: Corporation, organized under the laws of the state of Delaware.
 (Corporation, Partnership, Limited Partnership, Individual)

If a partnership, the bidder shall state below the names of the partners. If a corporation, the bidder shall state below the names of the president and of the secretary.

N/A

Person to Contact: Should IPSC desire information concerning this Proposal, please contact:

Name: Hansueli Krattiger Telephone No: 262 785 8596

Address: 16250 W. Glendale Dr., New Berlin, WI 53151

(If different, the address of bidder's chief executive office is:) _____

PART C - DIVISION C3**BIDDING DOCUMENTS - ADDITIONAL BID INFORMATION**

1. **Detailed Information:** The bidder shall submit complete and definitive information on its offering in sufficient detail to permit a complete analysis of the Proposal. The requirements stated in the Instructions to Bidders, relative to information submittal, shall be followed.

The requirements for information contained in this Division are basic requirements. Additional information shall be provided as requested by IPSC.

The blank data sheets included in this Division shall be completely filled in. The data listed therein shall not relieve Contractor of its responsibility for meeting the requirements of the Detailed Specifications.

The bidder shall not alter the original Proposal Data Division page numbers. If it becomes necessary to add pages, other than the end of the Division, a suffix such as a, b, c, etc., shall be added to the original number to designate the added page number. Pages added at the end of the Division shall be numbered sequentially by continuation of originally established numbering.

Where alternates are indicated in the Proposal or Proposal Data, the bidder shall provide complete information for each alternate.

2. **Drawings:** Drawings shall be submitted with the Proposal in sufficient detail to permit evaluation of the equipment offered and to permit preliminary arrangement studies to be made.

A plan view drawing showing the proposed equipment in the existing electrical equipment room shall be submitted. Contractor shall also include estimated weights for all equipment. Outdoor cooling equipment, if required, shall also be shown. External interconnection one-line diagram showing all power, control, and protection cabling required to complete the installation of the VFD systems.

3. **Supplementary Information:** The following supplementary information shall be submitted with the Proposal:

Supplementary Information
Complete Description of Proposed VFD. This Shall Include a Description of Shipping Components and Field Assembly Installation.
Summary Description of Codes and Standards Used If Different than Specified, Including a Review of Major Differences.

Supplementary Information
Identification of Any Modifications Required to IPSC's ID Fan System, Composed of ID Fan Motor, ID Fan, Connecting Shaft, Bearings, and Cable Connecting the ID Fan Motor to the VFD System to Allow this Equipment to Operate with the VFD While Maintaining a Normal Thirty (30) Year Lifetime of the ID Fan System.
Documentation Indicating Contractor's VFD System Does Not Produce Torsional Vibrations, Shaft Torsional Resonance, or Torque Pulsations Within the Connecting Shaft of the ID Fan System.
Documentation Indicating Contractor's VFD System Will Not Create Accelerated ID Fan System Bearing Wear Due to Common Mode Voltages Delivered by High Frequency PWM or Other Signals from Contractor's Inverter Drive.
Documentation Indicating Contractor's VFD System Does Not Contribute to Insulation Breakdown of the End Turns of the Motor Winding.
Names and Other Contact Information of Five (5) Purchasers of the Proposed VFD System Applied to Motors of 3,000 Horsepower (HP) and Above Who Have Had the Equipment Installed and Operating for at Least Two (2) Years.
Priced Preliminary Spare Parts List.
Input Current Including Harmonic Content at 25, 50, 75, 85, and 100 Percent Load.
Composite Data on Mean Time to Failure and Mean Time to Repair for Typical Components Contained Within the VFD System and Shown by Operating Experience to Fail or Require Replacement.
Detailed Description of the Installation Instructions of the Proposed Drive System Including All of Its Components and Any Modifications to Existing Equipment.
Description of the Failure Mode If Control Power Is Lost to the VFD Control System.
Description of VFD Operation When the Input Voltage Dips to 70 Percent.
Description of the Failure Modes of the Power Switching Devices (SCR, GTO, Diode, IGBT, IGCT, etc.), or Switching Device Control That Will Allow the Drive System to Continue to Operate Without Tripping the Fan.
Description of Accelerating and Decelerating Torque Programming Capabilities and Other Pertinent Capabilities and Limitations.
Preliminary Schedule.

DIVISION C3

ADDITIONAL BID INFORMATION

Supplementary Information
Harmonic Calculation.
Efficiency (At the Input to VFD Isolation Transformer) Graph with Y-Axis Indicating 25, 50, 75, 85, and 100 Percent Torque and X-Axis Indicating 25, 50, 75, 85, and 100 Percent Frequency.
Catalog Brochures.
Complete List of Required Maintenance Tools as Discussed in Division F3, Article 15, General Equipment Specifications. The Listing Shall Include a Complete Description and Quantity of Each Item.
Information Specified in Division B1, Instructions to Bidders.
Equipment Storage Requirements, Including Inside or Outside Requirements and Requirements for Controlled Temperature or Humidity, etc.
Description of Manufacturing, Testing, and Inspection Procedures.
Written Description, Logic Diagrams, or Ladder Diagram Indicating Recommended Operating Sequence.
Maintenance Activities Required by the Manufacturer And/or by Contractor to Provide Adequate Storage and to Maintain Valid Material and Equipment Warranties.
Motor Information If Motor Is Furnished from Division F9, Medium Voltage Induction Motors.
Transformer Information Division F8, VFD Isolation (VFDI) Transformers

4. Equipment and Material Data: Please provide the following equipment and material data to assist IPSC in evaluating the Technical Proposal:

Equipment and Material Data
Complete Description of the Proposed System Indicating Exactly What Is Being Replaced and What Is Being Reused.
A Drawing (the Plant Arrangement - AQCS Control Building Mezzanine Drawing May Be Marked up to Show Equipment Layout) Showing the Proposed Arrangement and Dimensions Including Clearances Between Existing Items and All New Items. This Drawing Shall Also Indicate the Approximate Weight of All Components and Any New Wall or Floor Penetrations.

DIVISION C3

ADDITIONAL BID INFORMATION

Equipment and Material Data
Guaranteed Reliability and Maintainability Times of the Proposed System.
Description of the Work Required for Complete Replacement.
A List of Maintenance Tools, Which Shall Be Furnished with the Equipment.
A Description of the Manufacturer's Standard Factory Test Procedure.
Expected and Maximum Heat Loss on a per Drive Basis.
A List of at Least Three (3) Sites and Names of Individuals That May Be Contacted Where Similar Equipment Has Been Retrofitted.
If a New Motor Is Being Provided, Verify That the Minimum Speed of 10 Percent Is Acceptable to the Motor Vendor.
Since the VFD Shall Be Suitable for Continuous Operation at Turning Gear Speed for Equipment Cool-down, Provide Information Describing the Operation at Turning Gear Speed.
Harmonic Analysis, Which Includes All Voltage and Current Harmonics up to the 49 th .
Any Alternate Access Options Required.
Heat Dissipation Data Necessary to Verify Adequacy of Existing HVAC System to Design a New HVAC System.
A Summary Description of Codes and Standards Used If Different than Specified Including a Review of Major Differences.
A Price List of Recommended Spare Parts.
A List of Any Special and Maintenance Tools Being Furnished.
Bidder's Experience Record with Proposed Equipment.
A List of Factory Routine Tests Being Proposed.
A Complete Description of the Extent of Shop Assembly of Components, and What Will Not Be Shop Assembled.
Efficiency Versus Load Curves Based on the Driven Equipment.

Equipment and Material Data
A Written Description of the Results of a Failure of Any Power Switching Device (SCR, GTO, Diode, IGBT, IGCT, etc.), or Switching Device Control. Contractor Shall Include the Sequence of Each Channel in the Write-up.
A Description of Why Rear or Side Access Is Needed.
Contractor Shall Confirm That All Power Components in the Converter Sections Will Be Mounted on a Swing Frame or Rack-out for Ease of Maintenance. If Not, Contractor Shall Describe Proposed Mounting Method.

Information for
"Base Proposal"

Spec. 45605

DIVISION C3

ADDITIONAL BID INFORMATION

Variable Frequency Drive System	
VFD Isolation Transformer Rating (kVA):	4378
System Input Voltage:	2 x 4031 V
System Output Voltage:	2 x 3876 V
Rated Drive Output Power (Continuous kVA):	6337
Rated Drive Output Current (Continuous A):	472
Nominal Load Power (HP):	7415
Rated VFD Input Current (A):	494
Nominal VFD Input Current at 8,200 HP Output (A):	529
Variable Frequency Drive	
Manufacturer and Model:	ABB 122-4042452
Overall Dimensions: (mm)	
Height (Inches):	2800 115"
Depth (Inches):	2250 89"
Width (Inches):	6250 246"
Shipping Height (Inches):	2400 98"
Length of Longest Shipping Piece (Inches):	6250 246"
Technology:	
Microprocessor-Based Multi-Level Switching:	LCI!
Phase/Frequency/Voltage (ph/Hz/V):	2x3/60/2x4031
Rectifier Device:	Thyristor
Inverter Device:	Thyristor
Cell Voltage (V):	5200V
Number of Cells:	4/branch

C3-6

IP7_025154

DIVISION C3

ADDITIONAL BID INFORMATION

Variable Frequency Drive	
In the Event of Any Power Switching Device (SCR, GTO, Diode, IGBT, IGCT, etc.), Failure, Will the VFD Continue to Operate at Full Rated Output?	Yes <u>X</u> No <u> </u>
If "No", Explain:	
Number of Pulses:	<u>12 pulse</u>
DC Link Capacitors:	Yes <u> </u> No <u>X</u>
Input Power Factor (30 to 100 Percent Speed) (Cos f):	<u>0.88</u>
Power Interrupt Ride-Through Duration (Cycles):	<u>≤ 4 sec.</u>
Voltage Dip (With Continuous Operation) (Percent):	<u>11</u>
VFD Output Voltage (V):	<u>2 x 3876</u>
Overload Capability for Sixty (60) Seconds (Percent):	<u>120</u>
Torque Pulsations Across Speed Range (Percent):	<u>same as existing</u>
Cooling Medium:	<u>Air</u>
Enclosure Protection:	<u>IP 30</u>
Ambient Temperature Maximum (°C):	<u>1 - 50</u>
Humidity (Non-Condensing) (Percent):	<u>5 - 85</u>
Altitude (Feet):	<u>≤ 2000 m</u>

DIVISION C3

ADDITIONAL BID INFORMATION

DC Link Reactor Data <i>(part of converter)</i>	
Manufacturer:	
Class and Type of Core:	
Insulating Liquid:	<i>dry type</i>
Quantity:	<i>1</i>
Nominal DC Voltage Rating (V):	<i>9675</i>
Continuous DC Current Rating (V):	<i>605 (876 @ 10000 Hz)</i>
Rated DC Load (kW):	<i>5853</i>
Conductor Material of Winding (If Aluminum, State Grade):	<i>Copper</i>
Basic Lightning Impulse Insulation Level (BIL) (kV):	<i>N/A</i>
Approximate Resistance at 75°C (OHM):	<i>< 80 mΩ</i>
Inductance (Henrys) (H):	<i>8.5</i>
Losses (Guaranteed):	<i>37 kW</i>
No-Load Loss (Excitation Only):	
At 100 Percent Voltage (kW):	
At 110 Percent Voltage (kW):	
Total Loss, No-Load Loss Plus Load Loss, With Full Rated DC Load (kW):	<i>37 kW</i>
Temperature Under Continuous Operation Guaranteed:	
Temperature Rise at Full Rated DC Load:	
Winding Temperature Rise by Resistance (°C):	<i>Acc. IEC 60289</i>
Hottest Spot Winding Temperature Rise (°C):	
Average Sound Level at Rated DC Load, Scale "A", Slow Response, at One (1) Foot from Reactor (DC):	

DIVISION C3

ADDITIONAL BID INFORMATION

DC Link Reactor Data	
Short Circuit Capability:	
DC Short Circuit Current (A):	
Maximum Duration of Short Circuit Current (Seconds):	
Weight and Dimensions: <i>Included in Converter !</i>	
Net Weights:	
Core and Coils (Pound):	
Insulating Liquid (Pound/Gallon):	
Total (Pounds):	
Heaviest Piece to Handle During Erection (Pounds):	
Overall Dimensions:	
Height (Inches):	
Depth (Inches):	
Width (Inches):	
Shipping Height (Inches):	
Tuned Filter Bank	
Is a Tuned Filter Bank Required for Harmonic Suppression:	Yes _____ No _____
If "Yes", Where Is it Mounted? (Include Dimensions and Weights):	<i>Outside Yard</i>
Drive Cooling System <i>Part of Converter</i>	
Manufacturer:	<i>ABB</i>
Cooling Methodology (Liquid/Air):	<i>Air</i>
Type of Liquid:	<i>N/A</i>
Is Cooling System 100 Percent Redundant:	Yes _____ No <u><i>X</i></u>
Net Weight (Pounds):	

DIVISION C3

ADDITIONAL BID INFORMATION

Harmonic Voltage Distortion			
Guaranteed Maximum Harmonic Voltage Distortion Contribution, Without Filters, to Auxiliary Electrical Power System Under the Worst Case Conditions:			
Harmonic	90 Percent	100 Percent	110 Percent
5			
7			
11			
13			
17			
19			
23			
25			
Total:			

Efficiency	
Guaranteed Overall System Efficiency at Rated Speed and Load (Percent):	98.36 %
Total Guaranteed System Losses at Rated Speed and Load (kW):	94.8 kW
System Speed Response	
Maximum Deceleration Rate (Rpm/Sec):	Acc. to Inertia
Maximum Acceleration Rate (Rpm/Sec):	Acc. to Inertia
Interface	
Type and Quantity of Communication Ports Which Are Included, (i.e., RS232, RS485, USB):	1 x RS485

PART D - DIVISION D1

CONTRACT DOCUMENTS DESCRIPTION

The Contract Agreement, together with the documents listed in Article 3 thereof, the Reference Specifications, any other documents listed below, and such of Contractors Proposal documents as are expressly agreed to by IPSC shall constitute the Contract (the Contract). Said Documents are complementary and require complete and finished Work. Anything shown or required of Contractor in any one or more of said documents shall be as binding as if contained in all of said documents. Contractor shall not be allowed to take advantage of any error, discrepancy, omission, or ambiguity in any document, but shall immediately report to the President and Chief Operations Officer, in writing, any such matter discovered. The President and Chief Operations Officer will then decide or correct the same and the decision will be final.

PART E - DIVISION E1
GENERAL CONDITIONS

Definitions: The following words shall have the following meanings:

- a. **Bidder:** The person, firm, or corporation adopting and submitting a Proposal under these Specifications.
 - b. **Buyer:** The Purchasing Agent for IPSC.
 - c. **Contract Administrator:** The IPSC employee designated by the President and Chief Operations Officer with primary responsibility for administration of the Contract, or other representatives designated by the Contract Administrator acting within the limits of their authority.
 - d. **Contractor:** The person, firm, or corporation to whom the Contract is awarded.
 - e. **Directed, Required, Approved, etc.:** The words *directed, required, approved, permitted, ordered, designated, prescribed, instructed, acceptable, accepted, satisfactory*, or similar words shall refer to actions, expressions, and prerogatives of the Contract Administrator unless otherwise expressly stated.
 - f. **Gallon:** Liquid volume of 231 cubic inches at 60 degrees Fahrenheit.
 - g. **IGS:** Intermountain Generating Station located at 850 West Brush Wellman Road, Delta, Utah 84624.
 - h. **IPA:** Intermountain Power Agency, the owner of Intermountain Power Project, and a political subdivision of the state of Utah, organized and existing under the Interlocal Co-operation Act, Title 11, Chapter 13, Utah Code Annotated 1953, as amended.
 - i. **IPP:** Intermountain Power Project, consisting of Intermountain Generating Station, Intermountain Railcar, Intermountain Converter Station, Adelanto Converter Station, Intermountain AC Switchyard and associated transmission lines, microwave stations, and support facilities.
 - j. **IPSC:** Intermountain Power Service Corporation, a nonprofit corporation, furnishing personnel to support the Operating Agent in the performance of operation and maintenance.
 - k. **Operating Agent, or LADWP:** The City of Los Angeles Department of Water and Power which is responsible for operation and maintenance for IPP.
 - l. **President and Chief Operations Officer:** The President and Chief Operations Officer of IPSC, or other representatives designated by the President and Chief Operations Officer acting within the limits of their authority.
 - m. **Reference Specifications:** Those bulletins, standards, rules, methods of analysis or tests, codes, and specifications of other agencies, engineering societies, or industrial associations referred to in these Specifications. These refer to the latest edition, including amendments published and in effect at the date of the Invitation for Proposal, unless specifically referred to by edition, volume, or date. Unless the context otherwise requires, Reference Specifications also include all amendments published or adopted after the date of the Invitation for Proposal. In the event of any subsequent revisions or changes thereto after the date of the Invitation to Proposal, Contractor assumes no responsibility for compliance therewith. If IPSC or Buyer desires a modification as a result of any such change or revision, it shall be treated as a change per Article 9 "Extra Work, Reduced Work, and Change Orders by IPSC."
 - n. **Subcontractor:** A person, firm, or corporation, other than Contractor and employees thereof, who supplies labor, services or materials for a portion of the Work to be performed by Contractor under the Contract.
 - o. **Ton:** The short ton of 2,000 pounds.
 - p. **Work:** The services, materials, equipment, and other performance identified in these Specifications and other Contract Documents to be provided by Contractor.
2. **Materials and Work:** All Work shall comply with these Specifications. All materials used or supplied, and all equipment furnished, shall be new and unused, but this requirement shall not preclude the use of recycled materials in the manufacturing processes. All Work shall be done by qualified workers in a thorough and workmanlike manner in accordance with commonly accepted industry practice that would pass without objection in both Contractors trade and IPA's and IPSC's industry. Materials, equipment, workmanship, and other Work not definitely specified, but incidental to and necessary for the Work, shall conform to the best commonly accepted commercial practice for the type of Work in question and be of a quality that passes without

objection in Contractor's trade and IPA's and IPSC's industry.

3. Nondiscrimination: The applicable provisions of Executive Order No. 11246 of September 24, 1965, and Bureau of Land Management regulations, and all other applicable governmental regulations pertaining to nondiscrimination in employment in the performance of contracts, are incorporated herein by reference, and made a part hereof as if they were fully set forth herein. During the performance of the Contract, Contractor shall not discriminate in its employment practices against any employee or applicant for employment because of the employee's or applicant's race, religion, national origin, ancestry, sex, age, or physical disability. All subcontracts awarded under or pursuant to the Contract shall contain a like nondiscrimination provision.
4. Governing Law: Venue: The Contract shall be governed by the substantive laws of the state of Utah, regardless of any rules on conflicts of laws or choice of law that would otherwise cause a court to apply the laws of any other state or jurisdiction. Any action, in law or in equity, concerning any alleged breach of or interpretation of the Contract, or concerning any tort in relation to the Contract or incidental to performance under the Contract, shall be filed only in the state or federal courts located in the state of Utah.
5. Patents and Intellectual Property: Contractor shall defend and fully indemnify and, at the election of IPA, defend IPA, IPSC, and the Operating Agent against any and all liability, whatsoever, by reason of any alleged infringement of any intellectual property rights (including, but not limited to, US patents, registered copyrights, trademarks, or trade secrets) on any article, process, method, or application used in any designs, plans, drawings, or specifications provided under the Contract, or by reason of Contractor's manner of performance under the Contract, or by reason of use by IPA, IPSC, or the Operating Agent of any article, process, or material specified by Contractor; provided that IPSC has given Contractor prompt written notice of such action, all necessary assistance in the defense thereof and the right to control all aspects of the defense thereof including the right to settle or otherwise terminate such action in behalf of IPSC.

Contractor shall have no obligation hereunder and this provision shall not apply to: (i) any other equipment or processes, including Work or Processes which have been modified or combined with other equipment or process not supplied by Contractor; (ii) any Work or Process supplied according to a design, other than an Contractor design, required by IPSC; (iii) any products manufactured by the Work or Process; (iv) any patent issued after the date hereof; or (v) any action settled or otherwise terminated without the prior written consent of Contractor.

If, in any such action, the Work is held to constitute an infringement, or the practice of any Process using the Work is finally enjoined, Contractor shall, at its option and its own expense, procure for IPSC the right to continue using said Work; or modify or replace it with non-infringing equipment or, with IPSC's assistance, modify the Process so that it becomes non-infringing; or remove it and refund the portion of the price allocable to the infringing Work. THE FOREGOING PARAGRAPHS STATE THE ENTIRE LIABILITY OF CONTRACTOR AND EQUIPMENT MANUFACTURER FOR ANY PATENT INFRINGEMENT.

To the extent that said Work or any part thereof is modified by IPSC, or combined by IPSC with equipment or processes not furnished hereunder (except to the extent that Contractor is a contributory infringer) or said Work or any part thereof is used by IPSC to perform a process not furnished hereunder by Contractor or to produce an article, and by reason of said modification, combination, performance or production, an action is brought against Contractor, IPSC shall defend and indemnify Contractor in the same manner and to the same extent that Contractor would be obligated to indemnify IPSC under this "Patent and Intellectual Property" provision.

All drawings, specifications, calculations, models, data, and other engineering documents (collectively "Drawings") shall be delivered to and be the property of IPSC upon payment in full

and to the extent not containing Contractor intellectual property. IPSC shall be entitled to use the Drawings and the information contained therein for the ~~construction, operation, maintenance, repair, alteration, improvement, and expansion~~ of IPP Facilities.

6. Contractors Address and Legal Service: The address given in the Proposal shall be considered the legal address of Contractor and shall be changed only by advance written notice to IPSC. Contractor shall supply an address to which certified mail can be delivered. The delivery of any written communication to Contractor personally, or delivery to such address, or the depositing in the United States Mail, registered or certified with postage prepaid addressed to Contractor at such address, shall constitute a legal service thereof.
7. Assignment of Contract Prohibited: Contractor shall not assign or otherwise attempt to dispose of the Contract, or any rights hereunder, or of any monies due or to become due hereunder, unless authorized by the prior written consent of the President and Chief Operations Officer, such approval not to be unreasonably withheld. The Contract, and Contractor's rights hereunder (including rights of collection) are nonassignable without the President and Chief Operations Officer's prior written consent. No right or claim can be asserted against IPA, IPSC, or the Operating Agent, in law or equity, by any person, by reason of any assignment or disposition unless so authorized.

If Contractor, without such prior written consent, purports to assign or dispose of the Contract, or any right or interest hereunder, IPSC may at its option terminate the Contract. Such termination shall relieve and discharge IPA, IPSC, and the Operating Agent from any and all liability, duties, and obligations to Contractor, and to any assignee or transferee thereof.

8. Quality Assurance: IPSC has the right to subject any or all materials, services, equipment, or other Work furnished and delivered under the Contract to rigorous inspection and testing. (Unless otherwise specifically provided in the Contract with respect to specific materials, services, equipment, or other Work, IPSC has no duty to inspect, test, or specifically accept.) Before offering any material, services, equipment, or other Work for inspection, testing, delivery, or acceptance, Contractor shall eliminate all items or portions which are defective or do not meet the requirements of these Specifications. If any items or portions are found not to meet the requirements of these Specifications prior to commencement of the warranty period, the lot, or any faulty portion thereof, may be rejected. Only the Contract Administrator may accept any material, service, equipment, or other Work as complying with these Specifications on behalf of IPSC.

IPSC may inspect and reject materials, services, equipment, or other Work tendered or purchased under the Contract at any reasonable location IPSC may choose (including, but not limited to, points of origin, while in transit to IPSC, IPSC specified receiving points, IPSC storage sites, or any point of use or installation). Inspection can include any testing that IPSC deems necessary or convenient to determine compliance with these Specifications. The expense of any initial tests will be borne by IPSC. All expenses of subsequent or additional tests will be charged against Contractor when due to failure of first-offered materials, services, equipment, or other Work to comply with these Specifications. If the order provides for factory acceptance testing, Contractor shall notify IPSC when Contractor will conduct such testing prior to shipment. Unless IPSC states specific objections in writing within ten (10) days after completion of factory acceptance testing, completion of the acceptance test constitutes IPSC's factory acceptance of the Work and its authorization for shipment. If the order provides for site acceptance testing, testing will be performed by Contractor personnel to verify that the Work has arrived at site complete, without physical damage, and in good operating condition. Completion of site acceptance testing constitutes full and final acceptance of the Work. If, through no fault of Contractor, acceptance testing is not completed within thirty (30) days after arrival of the Work at the site, the site acceptance test shall be deemed completed and the Work shall be deemed accepted.

The fact that the materials, services, equipment, or other Work have or have not been inspected, tested, or accepted by IPSC, whether voluntarily or as required by any specific provision in the Contract, shall not relieve Contractor of responsibility in case of later discovery of nonconformity, flaws, or defects prior to commencement of the warranty period. Upon commencement of the warranty period, such nonconformities will be corrected in accordance with the provision of Part E2, 1 "Guarantees", whether patent or latent.

9. Extra Work, Reduced Work, and Change Orders by IPSC: IPSC reserves the right at any time before final acceptance of the entire Work to order Contractor to furnish or perform extra Work, or to make changes altering, adding to, or deducting from the Work, without invalidating the Contract. Changes shall not be binding upon either IPSC or Contractor unless made in writing in accordance with this Article.

Changes will originate with the President and Chief Operations Officer who will transmit to Contractor a written request for a Proposal covering the requested change, setting forth the changed Work in detail, and including any required supplemental plans or specifications. Upon receipt of such request, Contractor shall promptly submit in writing to the President and Chief Operations Officer a Proposal offering to perform such change, a request for any required extension of time caused by such change, and an itemized statement of the cost or credit for the proposed change or specify any other affected provision of the Contract. Failure of Contractor to include a request for extension of time in the Proposal shall constitute conclusive evidence that such extra Work or revisions will entail no delay and that no extension of time will be required.

If Contractor's Proposal is accepted by IPSC, a written change order will be issued by the President and Chief Operations Officer stating that the extra Work or change is authorized and granting any required adjustments of the Contract price and of time of completion or change to any other affected provision. ~~If Contractor's Proposal is rejected by IPSC, then IPSC may order the additional or changed Work from other vendors.~~

Additional Work or changes pursuant to the change order shall be performed in accordance with the terms and conditions of these Specifications. No extra Work shall be performed or change made unless pursuant to such written change order, and no claim for an addition to the Contract price shall be valid unless so ordered.

Notwithstanding anything in the preceding paragraphs to this Article, IPSC may issue a written order reducing the Scope of Work ~~without issuing a request for Proposal.~~ Any such reduction in the Scope of Work shall be effective upon issuance. Reductions ordered by IPSC shall constitute partial terminations and shall reduce the price to be paid.

10. Changes at Request of Contractor: Changes may be made to facilitate the Work of Contractor. Such changes may only be made without additional cost to IPSC, without extension of time, and pursuant to written permission from the President and Chief Operations Officer. Permission for such changes shall be requested in writing by Contractor to the President and Chief Operations Officer.
11. Time is of the Essence and Extensions of Time: Time is of the essence to the Contract. Delivery and other performance of Work must be completed within the times and by the dates specified. Time for delivery or other performance of Work shall not be extended except as provided in this Article. Failure to deliver or otherwise perform Work within the times and by the dates specified for reasons not owing to those specified in (a), (b), or (c) below, shall constitute a default and be grounds for IPSC to immediately terminate the Contract. Shipping and delivery dates are contingent upon IPSC's timely approvals and delivery by IPSC of any documentation required for Contractor's performance hereunder.

If Contractor makes a timely written request in accordance with this Article, the time for delivery or other performance of Work will be extended by a period of time equivalent to any delay in the

whole Work plus a reasonable time to resume production which is: (a) Authorized in writing by the President and Chief Operations Officer; (b) Caused solely by IPSC; or (c) Due to unforeseeable causes (such as, but not limited to, war, strikes, or natural disasters) and which delay is beyond the reasonable control and without the fault or negligence of Contractor and subcontractors.

Contractor shall promptly notify the President and Chief Operations Officer in writing at both the beginning and ending of any delay, of its cause, its effect on the whole Work, and the extension of time claimed. Failure of Contractor to provide such written notices and to show such facts shall constitute conclusive evidence that no excusable delay has occurred and that no extension of time is required.

The President and Chief Operations Officer will ascertain the facts and the extent of the delay and will extend the time for delivery when the findings of fact justify such an extension. The President and Chief Operations Officer's determination will be final and conclusive.

IPSC will be responsible for granting extensions of time as herein provided, but will not otherwise be responsible in any manner or liable to any extent for damage directly or indirectly suffered by Contractor as a result of any delay.

12. **Protests and Claims:** If Contractor considers any demand of the President and Chief Operations Officer to be outside of the requirements of the Contract, or considers any amount of payment, or any record, ruling, or other act, omission, or determination by the President and Chief Operations Officer to be unreasonable, Contractor shall promptly deliver to the President and Chief Operations Officer a written statement of the protest and of the amount of compensation or nature of accommodation, if any, claimed.

Upon written request by the President and Chief Operations Officer, Contractor shall provide access to all records containing any evidence relating to the protest or claim.

Upon review of the protest, claim, and evidence, the President and Chief Operations Officer will promptly advise Contractor in writing of the final decision which will be binding on all parties.

The requirements of this Article shall be in addition to, and shall not be construed as waiving claims provisions of the Statutes of the state of Utah. Contractor is deemed to have waived and does waive all claims for extensions of time and for compensation in addition to the Contract price unless provided for in the Contract Documents except for protests and claims made and determined in accordance with this Article.

13. **Limitation of Liability: Responsible Party:** It is understood and agreed that IPA shall be the sole party or person liable to Contractor for payments under or pursuant to the Contract and for any breaches, defaults, or for any torts in the performance of or in relation to the Contract by IPA, IPSC, or the Operating Agent, or any officers, agents, or employees thereof. Contractor hereby expressly covenants and agrees that no suit shall be brought by Contractor against IPSC, or the Operating Agent, or their, or IPA's officers, agents, or employees, or any of the purchasers of power from IPA, but that all rights or remedies that Contractor may have or that may arise under or in relation to the Contract shall be asserted by Contractor solely against IPA. Without limiting the foregoing provisions of this Article, Contractor shall have no right against any of the foregoing (including IPA) to assert or recover, in contract or in tort, damages or losses in the nature of consequential damages, incidental damages, or punitive or exemplary damages.

14. **Independent Contractor:** Contractor shall perform all Work as an independent contractor in the pursuit of its independent calling. Contractor is not an employee, agent, joint venturer, partner, or other representative of IPA, IPSC, or the Operating Agent and shall be under the control of IPSC only to provide the Work requested and not as to the means or manner by which the Work is to be accomplished. Contractor has no authority to act for, bind, or legally commit IPA, IPSC, or the Operating Agent in any way.

15. Drug Policy: Contractor shall submit a current copy of its drug policy for review. IPP Facilities are a drug free and zero tolerance workplace. Contractors employees and its subcontractors' employees, who are to perform Work or otherwise be at the IPP Facilities, shall participate in a drug testing program prior to arrival, and at any additional time(s) during the Contract as IPSC may request.
16. Security and Safety Compliance: Contractor and its employees, agents, representatives, and/or subcontractors, while performing Work on IPP premises, or who are otherwise on IPP premises, shall fully comply with all security, fire prevention, and safety rules and procedures in force at IPP as are provided to Contractor in writing prior to commencement of Work. IPSC has the right (but not duty) to make periodic and random inspections of the persons, and of their respective property, upon entering, at any time while on, and when departing any IPP facility. Such persons subject to inspection include Contractor, any subcontractor, and their respective employees, agents, and representatives. Property subject to inspection includes, but is not limited to, vehicles, clothing, toolboxes, lunch boxes, any other carrying case, tools or equipment, and anything contained therein. If violations are noted, the violations will be reported to Contractor's on-site supervisor and the Contract Administrator for appropriate action.

All Contractors employees will be given security identification badges by IPSC and those badges shall be displayed each day to allow admittance on IPP premises. Contractor's employees who do not have security identification badges in their possession, will not be allowed on the IPP Job Site unless signed in by the Contract Administrator. All security identification badges shall be returned to the Security Contractor when the employee terminates their work at the IPP Job Site. All Contractor's vehicles will also receive parking stickers from the Security Contractor allowing entrance on IPP Premises. Temporary badges and parking stickers are available for intermittent Contractor employees and vehicles.

Contractor shall have access on IPP premises between the hours of 7:00 am to 7:00 pm Monday through Friday. Access may be allowed on weekends or at other times with the approval of the Contract Administrator.

Contractor will be directed to specified areas for parking vehicles and equipment by the Contract Administrator. Certain areas of IPP premises are restricted to IPSC vehicles only. Exceptions to the parking restriction will be made on an as needed basis through Contractors respective Contract Administrator. Contractor shall make its employees, agents, representatives, and/or subcontractors aware of all areas that are subject to restricted parking.

Contractor agrees, warrants, and represents that: (a) It is familiar with the risks of injury associated with the Work and otherwise being on IPP Premises; (b) Has reviewed the Work to be performed; (c) Has inspected the above ground and visible IPP Job Site with an IPSC representative; and (d) has determined that no unusual or peculiar risk of harm exists with regard to the Work to be performed on IPP Premises. Contractor further agrees that it shall, at all times, provide on IPP premises, a competent supervisor(s) familiar with IPSC's and the industry's safety standards to ensure compliance with all federal, state, and local regulations pertaining to safety (including, but not limited to, Federal and State OSHA, as said regulations relate to the Work to be performed under the Contract). Although IPSC assumes no responsibility to oversee or supervise the Work, IPSC reserves the right to review safety programs and practices and to make recommendations to Contractor. No such review or recommendation by IPSC shall impose any liability or responsibility on IPSC, or relieve Contractor from providing a safe working environment and complying with all legal requirements.

Contractor shall comply with IPSC's safety and equipment requirements as are provided to Contractor in writing prior to starting the Work. Worker protective clothing, which includes, but is not limited to, hardhats, safety glasses, safety shoes, gloves, respirators, earplugs, safety harnesses, and face shields shall be provided by Contractor.

Prior to starting the Work, all of Contractors personnel shall attend a safety orientation taught by a representative of IPSC. At Contractors option and subject to IPSC approval, a supervisor of Contractor may attend the orientation taught by IPSC, and then present the orientation to the remainder of Contractors personnel. In that case, a roll shall be provided to IPSC which lists each person who received the orientation and the date it was received.

17. Nonexclusive: This is a nonexclusive Contract. IPSC reserves the right to obtain services, materials, equipment, or other Work from other vendors or suppliers.

PART E - DIVISION E2

ADDITIONAL GENERAL CONDITIONS

1. Guarantee: Contractor guarantees and warrants for a minimum period of one (1) year after delivery, and for such longer period as may be specified by the applicable statute of limitations, that all materials, services, equipment, and other Work furnished are free from defects and otherwise conform to the terms of the Contract, including, but not limited to, the Article entitled "Materials and Work" in Part E, Division E1, General Conditions.

Contractor shall repair or replace, as IPSC may direct, all defective materials, services, equipment, or other Work. Such repair or replacement shall be F.O.B. at such destination as IPSC may direct (contract delivery point, point of installation, point of consumption, etc.). ~~IPSC's right to demand repair or replacement is in addition to any other remedies that may be available for breach of the foregoing guarantee and warranty.~~

Contractor shall, for the protection and benefit of IPA, IPSC, and LADWP, obtain guarantees conforming to the foregoing ~~two (2) paragraphs~~ this provision from each of its vendors and subcontractors with respect to their materials, services, equipment, or other portion of the Work. Such guarantees from vendors and subcontractors shall be in addition to, and not in lieu of, Contractor's own guarantees.

(a) The Warranty Remedy Period for new spare parts shall end twelve (12) months after date of shipment. The Warranty Remedy Period for refurbished or repaired parts shall end ninety (90) days after date of shipment. The Warranty Remedy Period for Services shall end ninety (90) days after the date of completion of Services.

(b) Work and Services Remedy. If a nonconformity to the foregoing warranty is discovered in the Work or Services during the applicable Warranty Remedy Period, as specified above, under normal and proper use and provided the Work has been properly stored, installed, operated and maintained and written notice of such nonconformity is provided to Contractor promptly after such discovery and within the applicable Warranty Remedy Period, Contractor shall, at its option, either (i) repair or replace the nonconforming portion of the Work or re-perform the nonconforming Services or (ii) refund the portion of the price applicable to the nonconforming portion of Work or Services. If any portion of the Work or Services so repaired, replaced or re-performed fails to conform to the foregoing warranty, and written notice of such nonconformity is provided to Contractor promptly after discovery and within the original Warranty Remedy Period applicable to such Work or Services or 30 days from completion of such repair, replacement or re-performance, whichever is later, Contractor will repair or replace such nonconforming Work or re-perform the nonconforming Services. The original Warranty Remedy Period shall not otherwise be extended.

(c) Exceptions. Contractor shall not be responsible for providing working access to the nonconforming Work, including disassembly and re-assembly of non-Contractor supplied equipment, or for providing transportation to or from any repair facility, all of which shall be at IPSC's risk and expense. Contractor shall have no obligation hereunder with respect to any Work which (i) has been improperly repaired or altered; (ii) has been subjected to misuse, negligence or accident; (iii) has been used in a manner contrary to Contractor's instructions; (iv) is comprised of materials provided by or a design specified by IPSC; or (v) has failed as a result of ordinary wear and tear. Work supplied by Contractor but manufactured by others is warranted only to the extent of the manufacturer's warranty, and only the remedies, if any, provided by the manufacturer will be allowed.

(d) Software Warranty and Remedies. Contractor warrants that, except as specified below, the Software will, when properly installed, execute in accordance with Contractor's published specification. If a nonconformity to the foregoing warranty is discovered during the period ending one (1) year after the date of shipment and written notice of such nonconformity is provided to Contractor promptly after such discovery and within that period, including a description of the nonconformity and complete information about the manner of its discovery,

Contractor shall correct the nonconformity by, at its option, either (i) modifying or making available to the IPSC instructions for modifying the Software; or (ii) making available at Contractor's facility necessary corrected or replacement programs. Contractor shall have no obligation with respect to any nonconformities resulting from (i) unauthorized modification of the Software or (ii) IPSC-supplied software or interfacing. Contractor does not warrant that the functions contained in the software will operate in combinations which may be selected for use by the IPSC, or that the software products are free from errors in the nature of what is commonly categorized by the computer industry as "bugs".

(e) THE FOREGOING WARRANTIES ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES OF QUALITY AND PERFORMANCE, WHETHER WRITTEN, ORAL OR IMPLIED, AND ALL OTHER WARRANTIES INCLUDING ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR USAGE OF TRADE ARE HEREBY DISCLAIMED. THE REMEDIES STATED HEREIN CONSTITUTE IPSC'S EXCLUSIVE REMEDIES AND CONTRACTOR'S ENTIRE LIABILITY FOR ANY BREACH OF WARRANTY.

2. Payment: Payment will be made within thirty (30) calendar days after receipt of the invoice in the form directed by IPSC with the Contract Documents.
3. Invoices: Invoices shall be submitted in duplicate to Accounts Payable, Intermountain Power Service Corporation, 850 West Brush Wellman Road, Delta, Utah 84624-9546. All letters pertaining to invoices shall be addressed to the foregoing address.

All invoices shall show the Contract number, release number, or other identification of each delivery covered by the invoice. In all cases, the amount of the applicable sales tax or use tax shall be separately stated on the invoice.

4. Regulations, Permits, Licenses, and Warrants: Contractor shall comply with all applicable federal, state, and local regulations including, but not limited to, Federal and State OSHA, as said regulations relate to the Contract, Contractors performance, or Contractors trade. In addition, Contractor shall ensure that all permits, licenses, and warrants relating to the Contract, Contractors performance, and Contractor's trade be acquired. Contractor warrants that the Work will comply with the relevant standards of the Occupational Safety and Health Act of 1970 ("OSHA") and the regulations promulgated thereunder as of the date of the Invitation to Proposal. Upon prompt written notice from the IPSC of a breach of this warranty, Contractor will replace the affected part or modify it so that it conforms to such standard or regulation. Contractor's obligation shall be limited to such replacement or modification. In no event shall Contractor be responsible for liability arising out of the violation of any OSHA standards relating to or caused by IPSC's design, location, operation, or maintenance of the Work, its use in association with other equipment of IPSC, or the alteration of the Work by any party other than Contractor.
5. Letters to IPSC: All inquiries relating to these Specifications prior to award of Contract shall be addressed to the Buyer.

After award of Contract, all letters pertaining to performance of the Contract (other than invoice) shall be addressed as follows:

Mr. George W. Cross
President and Chief Operations Officer
Intermountain Power Service Corporation
850 West Brush Wellman Road
Delta, UT 84624-9546

Attention: Jon Christensen, Contract Administrator

Regarding Contract No: 04-45605

6. **Limitation of Liability:** (a) In no event shall Contractor, its suppliers or subcontractors be liable for special, indirect, incidental or consequential damages, whether in contract, warranty, tort, negligence, strict liability or otherwise, including, but not limited to, loss of profits or revenue, loss of use of the Work or any associated equipment, cost of capital, cost of substitute equipment, facilities or services, downtime costs, delays, and claims of customers of the IPSC or other third parties for any damages. Contractor's liability for any claim whether in contract, warranty, tort, negligence, strict liability, or otherwise for any loss or damage arising out of, connected with, or resulting from this Contract Agreement or the performance or breach thereof, or from the design, manufacture, sale, delivery, resale, repair, replacement, installation, technical direction of installation, inspection, operation or use of any equipment covered by or furnished under this Contract Agreement, or from any services rendered in connection therewith, shall in no case (except as provided in the section entitled "Patent Indemnity") exceed one-half (1/2) of the purchase price allocable to the Work or part thereof or Services which gives rise to the claim. Notwithstanding its placement herein, this provision shall extend to the entire Contract Agreement.
- (b) All causes of action against Contractor arising out of or relating to this Contract Agreement or the performance or breach hereof shall expire unless brought within one year of the time of accrual thereof.
- (c) In no event, regardless of cause, shall Contractor be liable for penalties or penalty clauses of any description or for indemnification of IPSC or others for costs, damages, or expenses arising out of or related to the Work and/Services.
7. **Software License:** (a) Contractor owns all rights in or has the right to sublicense all of the Software, if any, to be delivered to IPSC under this Contract Agreement. As part of the sale made hereunder IPSC hereby obtains a limited license to use the Software, subject to the following: (i) The Software may be used only in conjunction with equipment specified by Contractor; (ii) The Software shall be kept strictly confidential; (iii) The Software shall not be copied, reverse engineered, or modified; (iv) The IPSC's right to use the Software shall terminate immediately when the specified equipment is no longer used by the IPSC or when otherwise terminated, e.g. for breach, hereunder; and (v) the rights to use the Software are non-exclusive and non-transferable, except with Contractor's prior written consent.
- (b) Nothing in this Contract Agreement shall be deemed to convey to IPSC any title to or ownership in the Software or the intellectual property contained therein in whole or in part, nor to designate the Software a "work made for hire" under the Copyright Act, nor to confer upon any person who is not a named party to this Contract Agreement any right or remedy under or by reason of this Contract Agreement. In the event of termination of this License, IPSC shall immediately cease using the Software and, without retaining any copies, notes or excerpts thereof, return to Contractor the Software and all copies thereof and shall remove all machine readable Software from all of IPSC's storage media.
8. **Export Control :** IPSC represents and warrants that the Work and Services provided hereunder and the "direct product" thereof are intended for civil use only and will not be used, directly or indirectly, for the production of chemical or biological weapons or of precursor chemicals for such weapons, or for any direct or indirect nuclear end use. IPSC agrees not to disclose, use, export or re-export, directly or indirectly, any information provided by Contractor or the "direct product" thereof as defined in the Export Control Regulations of the United States Department of Commerce, except in compliance with such Regulations.

PART F - DIVISION F1

DETAILED SPECIFICATIONS - SPECIAL CONDITIONS

1. General: Under the terms of the Contract, Contractor shall furnish and deliver up to eight (8) Induced Draft Fan Medium Voltage Variable Frequency Drive Systems ordered by IPSC during the period of four (4) years beginning with date stated in the first introductory paragraph of the Contract Agreement (hereinafter called the Contractual Period).
2. Quantity: IPSC agrees to purchase up to eight (8) Induced Draft Fan Medium Voltage Variable Frequency Drive Systems during the Contractual Period.

In consideration of the above agreed purchase quantity, IPSC will, during the Contractual Period, have the option (but not duty) to purchase Induced Draft Fan Medium Voltage Variable Frequency Drive Systems up to a quantity of eight (8). Said option may be exercised, in whole or in part, by the issuance to Contractor of releases for any portion thereof by the Buyer or the Buyers duly authorized representative. Nothing contained herein shall require IPSC to order any of its requirements beyond the approximate quantities stated in Division A1 from Contractor as opposed to from other suppliers or contractors.

3. Delivery: Contractor shall make deliveries only upon receipt of releases issued by the Buyer. IPSC reserves the right to specify in said releases the amounts and dates of deliveries at the location described in the Proposal Schedule. IPSC will require ID fans to be delivered as indicated in Division F2, Article 15, Schedule of Activities, in the table titled, Work to be Delivered to the Job Site.

Deliveries shall be made between the hours of 8:00 a.m. and 3:00 p.m., except holidays, Monday through Friday, unless other arrangements are made in writing between Contractor and Buyer.

4. Printed Documents: All printed documents, including drawings and instruction books, if applicable, shall be in the English language. All units of measurement shall be in the English foot-pound-second system.
5. Delivery Arrangements: After award of the Contract and prior to delivery or other performance of any Work, Contractor shall become familiar with the unloading facilities at the delivery point(s) set forth in the Proposal Schedule, either by personal inspection or by contacting the Contract Administrator, (435) 864-4414.
6. Indemnity Clause: Contractor undertakes and agrees to defend, indemnify, hold harmless, and at the option of the IPA, defend IPA, IPSC, LADWP, and any and all of their boards, officers, agents, representatives, employees, assigns, and successors in interest from and against any and all suits and causes of action, claims, charges, costs, damages, demands, expenses (including, but not limited to, reasonable attorneys' fees and cost of litigation), judgments, civil fines and penalties, liabilities or losses of any kind or nature, including, but not limited to, violations of regulatory law, breach of contract, death, bodily injury or personal injury to any third person, including Contractors employees and agents, or damage or destruction to any third party property of either party hereto, or of third persons, arising in any manner by reason of or incident to the extent attributable to negligent performance of the Contract on the part of Contractor, or Contractor's officers, agents, employees, or subcontractors of any tier, except as may be caused by the sole negligence of IPA, IPSC, LADWP, or their boards, officers, agents, representatives, or employees, assigns, and successors in interest.
7. Insurance Requirements: Prior to the start of the Work, but not later than thirty (30) calendar days after date of award of Contract, Contractor shall furnish IPSC evidence of coverage from insurers reasonably acceptable to IPSC and in a form acceptable to IPSC Insurance Analystan Accord

form. Such insurance shall be maintained by Contractor and at Contractor's sole cost and expense.

Such insurance shall not limit or qualify the liabilities and obligations of Contractor assumed under the Contract. IPA, IPSC, or LADWP shall not, by reason of any of their inclusion under these policies or otherwise, incur liability to the insurance carrier for payment of the premium for these policies.

Any insurance carried by IPA, IPSC, or LADWP which may be applicable is and shall be deemed excess insurance, and Contractor's insurance is and shall be primary for all purposes despite any provision in Contractor's policies to the contrary.

Should any portion of the required insurance be on a "Claims Made" policy, Contractor shall, prior to the policy expiration date following completion of the Work, provide evidence that the "Claims Made" policy has been renewed or replaced with the same limits and terms and conditions of the expiring policy at least for the Contract under which the Work was performed.

- a. Workers' Compensation/Employers Liability: Workers' Compensation Insurance covering all of Contractor's employees in accordance with the laws of all states in which the Work is to be performed and including Employer's Liability Insurance, and as appropriate, Broad Form All States Endorsement, Voluntary Compensation, Longshoremen's and Harbor Workers' Compensation, Jones Act, and Outer-Continental Shelf coverages. The limit for Employers Liability coverage shall be ~~not less than~~ \$1 million each accident and shall be a separate policy if not included with Workers' Compensation coverage. Evidence of such insurance shall be an endorsement to the policy providing for a thirty (30) calendar days prior written notice of cancellation or nonrenewal of a continuous policy to IPSC, by receipted delivery, ~~and a Waiver of Subrogation in favor of IPA, IPSC, and LADWP, its officers, agents, and employees.~~ Workers' Compensation/Employers Liability exposure may be self-insured provided that IPSC is furnished with a copy of the certificate issued by the state authorizing Contractor to self-insure. Contractor shall notify IPSC, by receipted delivery, as soon as possible of the state withdrawing authority to self-insure.
- b. Commercial Comprehensive General Liability: Commercial General Liability with Blanket Contractual Liability, Products and Completed Operations, Broad Form Property Damage, Premises and Operations, Independent Contractors; and Personal Injury coverages included. Such insurance shall provide coverage for total limits actually arranged by Contractor, ~~but not less than~~ of \$2 million Combined Single Limit and be specific for the Contract. Should the policy have an aggregate limit, such aggregate limits ~~should not be less than~~ shall be \$4- 2 million. Umbrella or Excess Liability coverages may be used to supplement primary coverages to meet the required limits. Evidence of such coverages shall ~~be on IPSC's Additional Insured Endorsement Form or on an endorsement of the policy acceptable to IPSC and provide for the following:~~
 - (1) ~~To include IPA, IPSC, LADWP, and their officers, agents, and employees as additional insured with the Named Insured for the activities and operations under and in connection with the Contract.~~
 - (2) That the insurance is primary and not contributing with any other insurance maintained by IPA, IPSC, or LADWP.
 - (3) A Severability-of-Interest or Cross-Liability Clause such as: "The policy to which this endorsement is attached shall apply separately to each insured against whom a claim is made or suit is brought, except with respect to the limits of the company's liability."

(4) That the policy shall not be subject to cancellation, change in coverage, reduction of limits or nonrenewal of a continuous policy, except after written notice to IPSC, by receipted delivery, no less than thirty (30) calendar days prior to the effective date thereof.

(5) A description of the coverages included under the policy.

c. ~~Commercial Comprehensive Automobile Liability: Commercial Comprehensive~~ Automobile Liability covering the use of owned, nonowned, hired, and leased vehicles for total limits actually arranged by Contractor, ~~but not less than~~ of \$1 million Combined Single Limit. Such insurance shall include Contractual Liability coverage. The method of providing evidence of insurance and requirements for additional insureds, primary insurance, notice of cancellation, and Severability-of-Interest shall be the same as required in the ~~Commercial Comprehensive~~ General Liability Division of terms and conditions.

d. ~~Professional Liability: Contractor shall provide Professional Liability Insurance with Contractual Liability coverage included, covering Contractors liability arising from errors and omissions made directly or indirectly during the execution and performance of the Contract and shall provide coverage of \$5 million Combined Single Limit. Evidence of such insurance shall be in the form of a special endorsement of insurance and shall include a Waiver of Subrogation against IPA, IPSC, and LADWP, their officers, agents, and employees.~~

The policy shall not be subject to cancellation, change in coverage, reduction of limits, or nonrenewal of a continuous policy, except after written notice to IPSC, by receipted delivery, not less than thirty (30) calendar days prior to the effective date thereof.

e. Other Conditions:

(1) Failure to maintain and provide acceptable evidence of any of the required insurance for the required period of coverage shall constitute a major breach of Contract, upon which IPSC may immediately terminate or suspend the Contract. In addition or in the alternative, IPSC has the right (but not duty), to procure such insurance and: (a) To deduct the cost thereof from any monies due Contractor under the Contract or otherwise; and/or (b) To charge and collect the cost thereof from Contractor, payable upon demand. Such claim, deduction, or charge shall include an administrative fee of two (2) percent of the cost of procuring said insurance. Said insurance may be procured and maintained in the name of Contractor, IPA, IPSC, LADWP, and/or any combination thereof, as primary and/or secondary insured, all as IPSC may from time to time elect.

(2) Contractor shall be responsible for all subcontractors' compliance with these insurance requirements. The foregoing remedies in subsection (1) shall be available to IPSC against Contractor for any failure by any subcontractor to maintain and provide the required insurance.

8. Transportation: All shipments of hazardous materials under the Contract or in connection herewith shall be handled in accordance with current U.S. Department of Transportation regulations and all other applicable federal, state, and local laws and regulations.

9. Material Safety Data Sheets: Contractor shall furnish IPSC with a Material Safety Data Sheet (MSDS) for all hazardous materials furnished under the Contract, used, stored, or transported on or near IPP premises in connection with the Contract. The MSDS shall be furnished to IPSC on, or prior to, the date of the first delivery, use, storage, or transportation of the materials or equipment. If these Specifications require that Contractor furnish instruction books, the MSDS

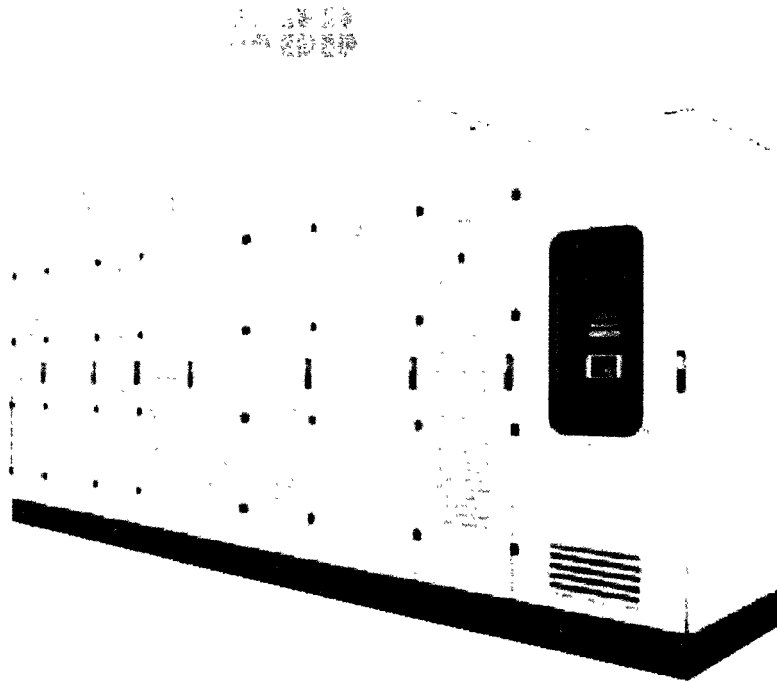
shall also be included in such books.

10. Contract Termination:

- a. For Convenience or Security: IPSC reserves the right, by giving twenty (20) calendar days prior written notice (or such longer notice as IPSC may select) to Contractor, to terminate the whole or any part of the Contract at IPSC's convenience, whether or not Contractor is in default. IPSC also reserves the right to terminate the Contract, effective immediately upon notice, for purposes of security or safety of IPP Facilities, persons who work at IPP Facilities, or the public. In the event of termination for convenience, security, or safety, IPA will pay Contractor reasonable and proper direct costs of termination (if, however, Contractor's Proposal includes cancellation charges, payment for termination costs shall not exceed the cancellation charges set forth therein). Contractor shall, after consultation with IPSC, take all reasonable steps to minimize the costs related to termination. Contractor shall provide IPSC with an accounting of costs claimed, including adequate supporting information and documentation and IPSC may, at its expense, audit the claimed costs and supporting information and documentation.
- b. For Breach: IPSC may terminate the whole or any part of the Contract effective immediately upon written notice, in the event Contractor is in material default, and without right on the part of Contractor to claim any termination costs. This right to terminate is in addition to, and not in lieu of, any other remedy provided in the Contract or otherwise provided by law or equity. No termination by IPSC for default shall be effective unless, within fifteen (15) days after receipt by Contractor of IPSC's written notice specifying such default, Contractor shall have failed to initiate and pursue with due diligence correction of such specified default.
- c. Limitation of Liability: In no event shall termination of this Contract, or any portion thereof, whether for convenience, security, safety, breach, or otherwise, constitute the basis for or result in any claim by Contractor for consequential or incidental damages (including loss of anticipated profits or other economic damages) or punitive damages, and Contractor hereby releases IPA, IPSC, and LADWP, and their officers, directors, employees, agents, and representatives, from any and all such claims or liability.

11. Suspension of Work: IPSC reserves the right to suspend and reinstate execution of the whole or any part of the Contract and the Work without invalidating the provisions of the Contract. In the event the Work is suspended, Contractor will be reimbursed for actual direct unavoidable costs that it reasonably incurs as a result of the suspension. Claims for such cost reimbursement shall be submitted by invoice. Contractor shall use all reasonable means to minimize such costs, and shall allow IPSC to audit costs claimed. Contractor shall, upon request by IPSC, provide a projection of costs it anticipates to incur during any suspension, or continuation of suspension, contemplated by IPSC. In no event shall suspension constitute the basis for, or result in, any claim for consequential or incidental damages (including loss of anticipated profits or other economic damages) or punitive damages, and Contractor hereby releases IPA, IPSC, and LADWP, and their officers, directors, employees, agents, and representatives, from any and all such claims or liability.

12. No Waiver: No breach, noncompliance, or other failure to perform (collectively "breach") by Contractor, or any subcontractor, or of any Work shall be deemed waived unless expressly waived in writing by the President and Chief Operations Officer. No waiver by IPSC of any one breach shall be deemed to waive any other prior, concurrent, or subsequent breach. No exercise, or failure to exercise, or delay in exercising any particular remedy by IPSC shall be deemed a waiver or preclude IPSC from subsequently invoking that remedy for that breach or any other breach. Unless otherwise specified, all remedies granted to IPSC in the Contract, or by law or equity, are cumulative and may be exercised in any combination or order.



MEGADRIIVE-LCLSO
Static Frequency Converter
Rated output power 3MW

TENDER

ATDA 3082202A

Technical Part

Air-Cooled LCI DRIVE

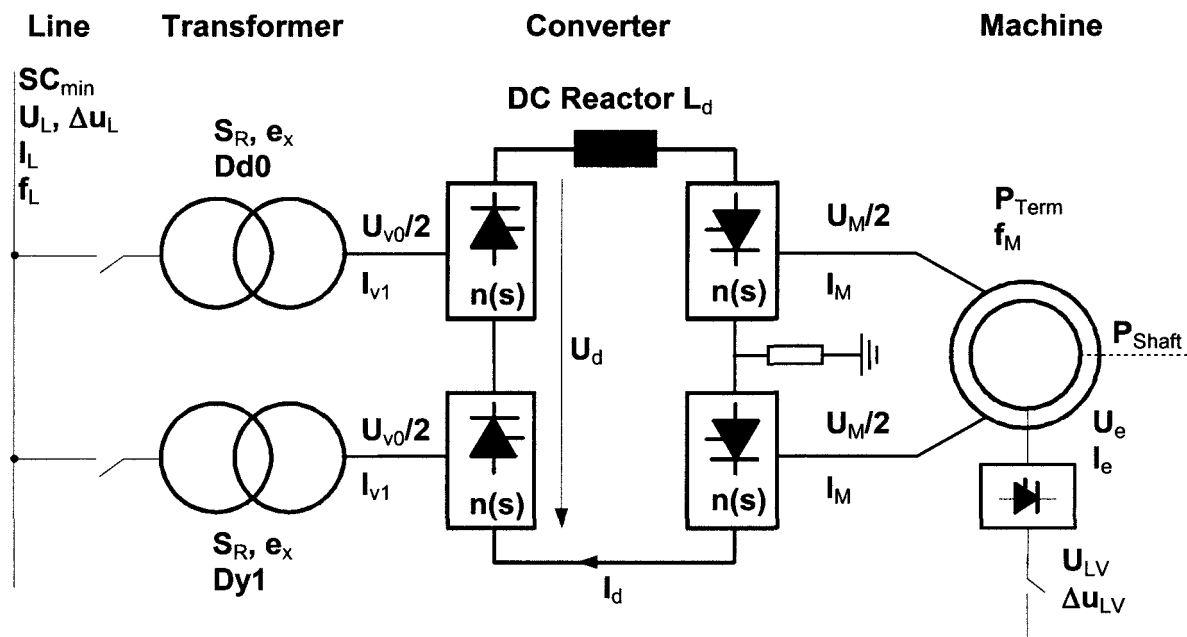
intended for

Intermountain Power
Service Corporation, USA

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1. Design Data



Main Data

Line

line voltage	U_L	[kV]	6.9
line-voltage tolerance	Δu_L	[%]	+10 / -10 ¹
line frequency	f_L	[Hz]	60
min. short-circuit power	SC_{min}	[MVA]	150
max. short-circuit power	SC_{max}	[MVA]	382

Transformer (existing, used at tap position -2.5%)

rated power	S_R	[kVA]	4378
rated no-load voltage secondary side	$U_{v0}/2$	[V]	4031
rated transformer sec. current (r.m.s.)	I_{v1}	[A]	627
short-circuit impedance	e_x	[%]	7.0
vector group			Dd0 and Dy1
actual no-load voltage secondary side	$U_{v0}/2$	[V]	4132
actual transformer sec. current (r.m.s.)	I_{v1}	[A]	494

¹ Speed reduction from -5 to -10 % line voltage tolerance



Converter

MEGADRIVE – LCI.DR

construction		A1212-404R452
rated converter AC current (rms)	I_{V1} [A]	494
@ 8200 hp	I_{V1} [A]	554
@ 10000 hp	I_{V1} [A]	715
quantity and type of thyristor		96 * 3BHB 010085
quantity of thyristors per branch	$n(s)$	3 + 1
cooling medium		air
max. inlet temperature	T_{in} [°C]	50

DC reactor

inductance	L_d [mH]	8.5
direct voltage	U_d [V]	9675
rated direct current	I_d [A]	605
@ 8200 hp	I_d [A]	678
@ 10000 hp	I_d [A]	876

Machine

Converter Operation

shaft rating	P_{Shaft} [kW / hp]	5529 / 7415
number of stator windings		2
service voltage	$U_{M/2}$ [V]	3876
service current (fund.)	I_M [A]	472
service frequency	f_M [Hz]	63.6
fund. power factor	$\cos\varphi_M$ [-]	-0.9

Rating

apparent power	S_{M1} [kVA]	6337
rated voltage	$U_{M1/2}$ [V]	3876
rated current (fund.)	I_{M1} [A]	472
rated frequency	f_{M1} [Hz]	63.6
rated speed	n [rpm]	954
commutation reactance	x_{cM} [%]	10

Excitation (Converter Operation)

excitation voltage	U_e [V]	t.b.a.
excitation current	I_e [A]	t.b.a.
excitation frequency	f_e [Hz]	60

Auxiliary supply

auxiliary voltage	U_{LV} [V]	480 (±10%)
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Converter efficiency

100% speed / 7415 hp:	[%]	98.36
80% speed / 3796 hp:	[%]	97.80
50% speed / 926 hp:	[%]	93.20

Converter Heat Dissipation

100% speed :	[kW]	94.8
80% speed :	[kW]	66.2
50% speed :	[kW]	53.1

Line side power factor @ 6.9 kV, 237 MVA without filter or power factor compensation system

100% speed / 7415 hp:	[-]	0.88
80% speed / 3796 hp:	[-]	0.72
50% speed / 926 hp:	[-]	0.43

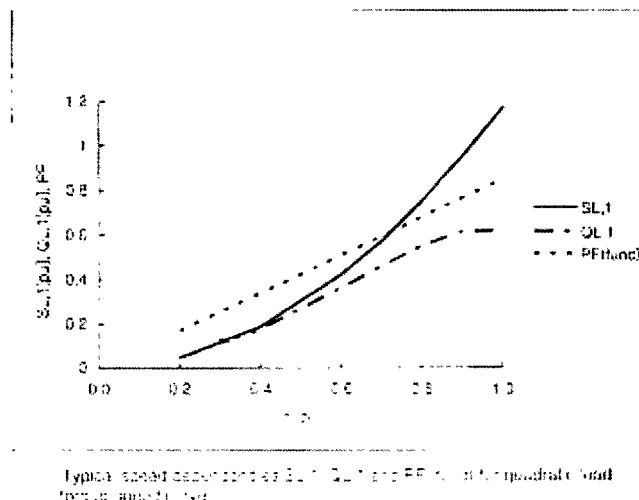
2. Harmonic Filters - Item 200

Per 6.9 kVBus system, (1) one 6.5 MVar Harmonic filter unit required for two LCI-drives. We assume outside power yard installation for the filters.

The harmonic filters are designed to the existing conditions of the system. Only harmonics generated by the SFC converter are considered, those generated by other consumers are not included in the design. The design bases on the available technical data and results in a filter of approx. 6.5 Mvar, which is subject to change at the detail design stage. See also the attached preliminary harmonics study for several load points. This study assumes worst case short circuit data, e.g. no contribution from fixed speed motors connected to the 6.9 kV bus.

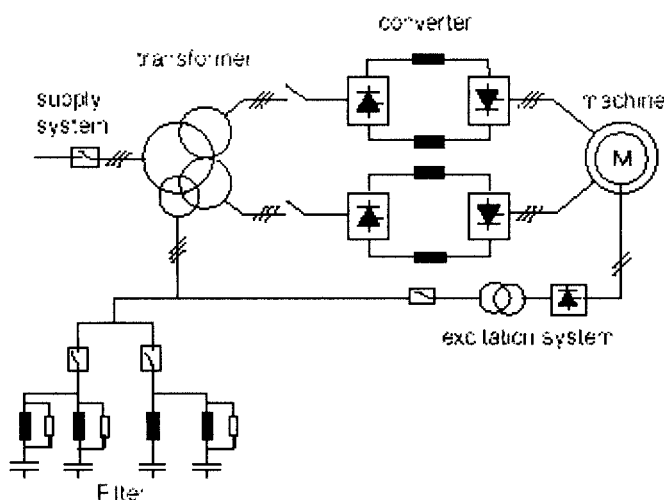
Included in the scope for the filters are all capacitor banks, reactors and resistors, supports, material for internal connections between the parts. Minimum two tuned filter circuits are required and for each branch two CT's and unsymmetry supervision are provided. Breakers and control for the breakers, foundation, installation and commissioning are not included in the scope.

Apparent power (SL), reactive power (QL) and power factor (PF) without power factor correction filter are shown in the graph below.



Approx. 6.5 MVar are required to provide a Power Factor $PF > 0.95$ at the Point of Common Coupling PCC for any load point for two LCI drives. The filter will be designed in individual L/C traps, tuned to the harmonics, e.g. 3rd and 5th harmonics. This filter would be connected to 6.9 kV via a separate breaker (not in scope).

A smaller filter for one drive only may also be connected at a tertiary transformer winding of e.g. 4160 V. We assume the filter option will be considered upon executing the power increase. Thus, new transformers would be required. These new transformers could be designed with tertiary windings for filter connection. The filter components (reactors, capacitors and resistors) will be delivered loose, and should be installed in the switchyard. Below is a typical single line diagram for the configuration with the tertiary transformer winding.



The budgetary price indication for this item 200 considers the filter design, the components (capacitors, reactors, resistors, filter breaker).

3. Input Transformer

Existing input transformer will be re-used with the ABB LCI.

4. Brushless Synchronous Motor

Existing Synchronous Motor, inclusive brushless exciter will be re-used with ABB LCI.

5. General Description

This section describes the dimensions, mechanical design, corrosion protection and painting, HV connections, Aux. and signal cables, permanent grounding connection, safety maintenance grounding as well as principle of operation.

The **air-cooled** A-version MEGADRIVE-LCI.DR frequency converters are available in the following standard configurations:

- one-channel 12/12-pulse series connection (... 1212 type), Fig. 1a

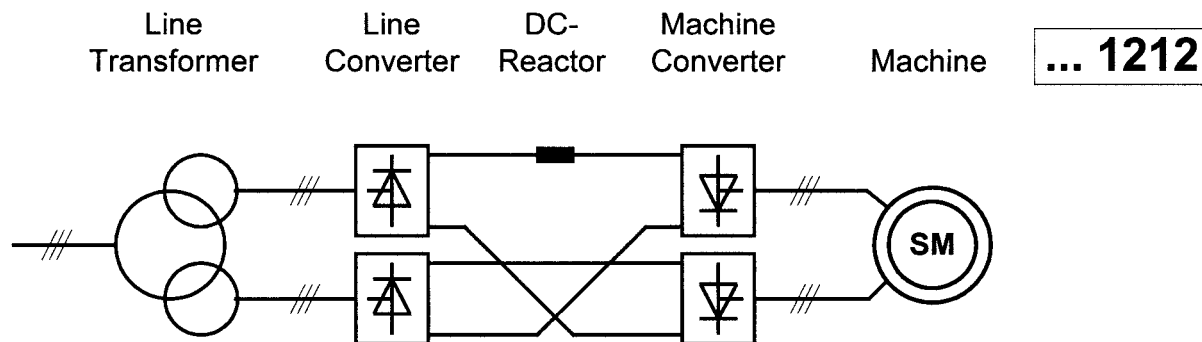
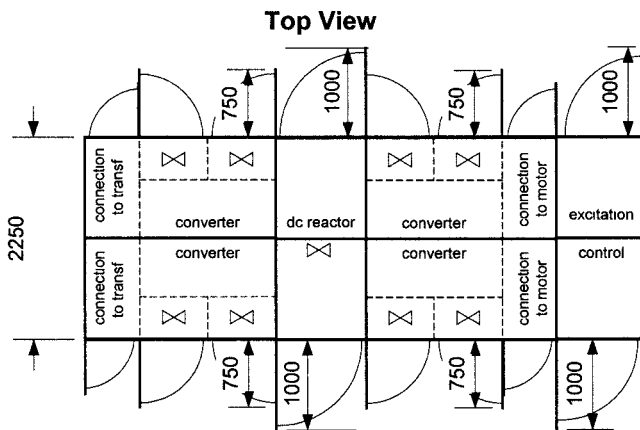
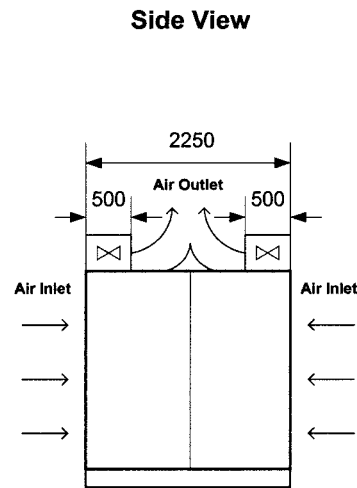
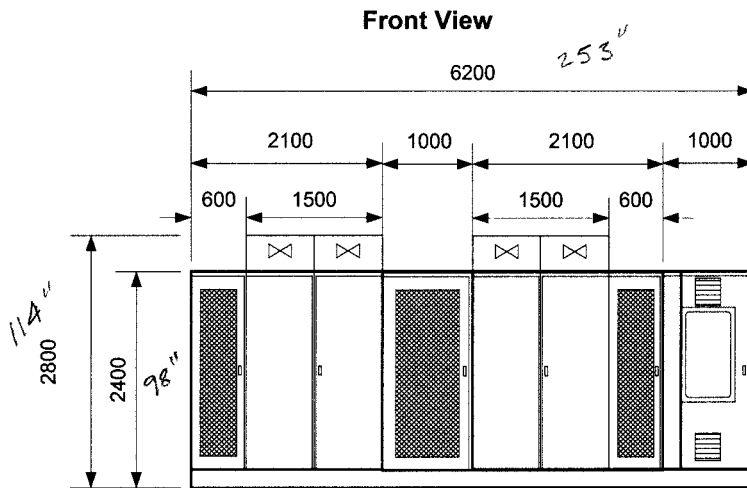


Fig. 1a One-channel 12/12-pulse series connection (... 1212 type)

6. Main data of the Static Frequency Converter (SFC)

Standard Cabinet Solution – 1 transport unit - Item 100

The LCI Drive will be delivered in one single transport unit configuration. The door clearance in the building needs to be adjusted to accommodate the drive 6,2*2,25*2,4m. The fans will be assembled at site.



Minimal clearance to the wall in:

Front Side: 1500 mm

Rear Side: 1500 mm

Left Side: 100 mm

Right Side: 100 mm

Weight: ca. 8'500 kg

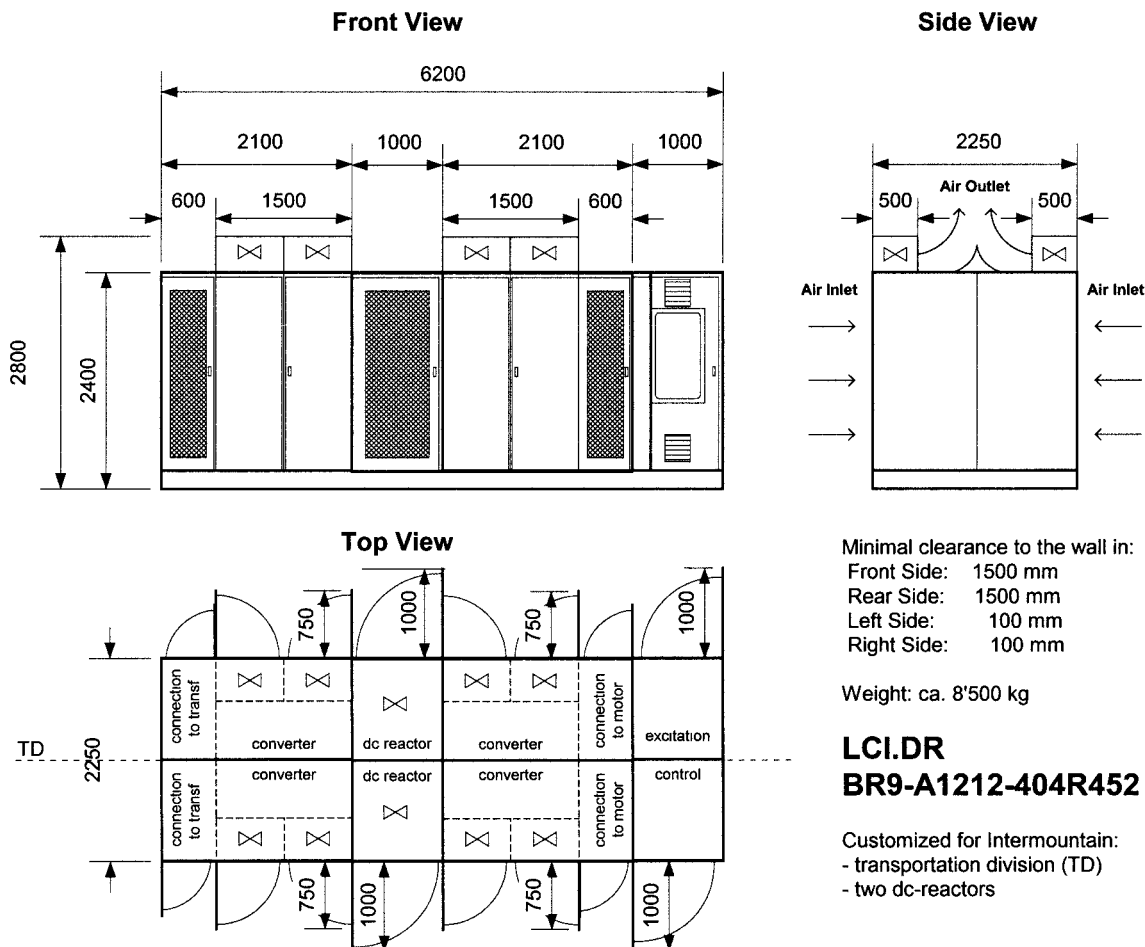
18,700 lbs

LCI.DR

BR1-A1212-404R452

Split Cabinets Solution – 2 transport units - Item 110

The LCI Drive will be delivered in two separate units (splitted in the middle x-axis), in order to fit through existing door. Each transport unit is composed of a converter 6,2*1,13*2,4 meters, fans dismantled. The two units will be assembled together incl. fans, according to above view, when on final location.





Applicable Standards

Our standard ABB LCI.DR fullfills following codes and standards:

General	IEC 60146-1-1Semiconductor converters
Insulation coordination within low voltage system	IEC 60664-1
Climatic, chemical and mechanical conditions	IEC 60721-3-1Storage
	IEC 60721-3-2Transportation
	IEC 60721-3-3Stationary use at weather protected locations (operation)
Safety	IEC 61800-5-1
Reactor	IEC 60289
Transformers	IEC 60076
Quality	ISO 9001
Environment	ISO 14001



The **air-cooled** (A-Version) MEGADRIVE-LCI.DR converter equipment basically includes the following parts:

- air-cooled power part (thyristor units for line and machine converters with heat sinks, RC-snubber-circuits, gate firing circuits, current and voltage transformers; line overvoltage protection)
- DC reactor
- converter control unit (control, protection and monitoring, operators panel, auxiliary distribution and excitation converter).

All above mentioned parts are mounted in a converter block, forming a single assembly for transportation; the DC reactor(s) is (are) integrated in the converter block.

Standard converter block design features

a) Cooling system

Primary cooling medium
ventilation

air inlet
air outlet

air
forced; by fan installed on the top
of the block
through front doors
via roof

b) Mechanical design

Block

welded and riveted cubicles,
bolted together,
profile thickness 2.5 mm

Enclosure

panels, doors, roof
metal sheet thickness 2 mm

Mounting of doors

with 4 hinges

Door locks

medium voltage → two-way key
low voltage/cooling → square key

Degree of protection

- doors closed

IP 30

- doors open

- power part
- DC reactor
- control, auxiliaries

IP 00
IP 00
IP 20

c) Corrosion protection and painting

Block and enclosure

- pre-treatment

phosphatizing and passivation



- 1st top coat (outside)
paint colour

electrostatic immersion
RAL 7032 (light grey)

- 2nd top coat
outside surface
paint colour
dry layer thickness

powdered
RAL 7035 (light grey)
 $55 \pm 5 \mu\text{m}$

d) Identification

Block

rating plate on front side
Plastic black on white

Cubicles

adhesive label, top right hand
Corner, black on white

Built-in components

adhesive label, both on component
and on place of mounting
label made of halogen free plastic
with black printing

Cable/wire marking

as option only

e) Internal cabling, wiring and busbars

Conductor

copper

Insulation

antitoxic, flame retardant halogen-
and chlor-free

Colour

earthing: yellow/green
all others: black

Busbars

bright copper

Connection technique

wires with ferrules
strands with sleeves
cables with lugs
busbars bolted

Cable ducts

halogen-free plastic
flame retardant

f) Converter block interfaces (cables, piping,)

Power connections:

- entry from bottom



- connection points are prepared for the connection of power cables as follows:

- | | |
|-------------------------------------|-----------------------------|
| - quantity per phase to transformer | max. 4 (single-core cables) |
| to motor | max. 4 (single-core cables) |
| - outside diameter of cables | $\leq 45 \text{ mm}$ |
| - cross-section | $\leq 400 \text{ mm}^2$ |
| - connection point | copper-busbar, 18 mm bore |

Auxiliary and signal cables:

- cable entry from bottom
- connection to screwed terminals

Earthing connection points:

- permanent earthing:
 - on internal protection earthing busbar external cable $\geq 150 \text{ mm}^2$
 - on internal isolated power part earthing busbar external cable $\geq 16 \text{ mm}^2$
- maintenance safety earthing:
 - earthing studs at incoming and outgoing busbars

g) Standard accessories

Door monitoring and contacts
Lighting

Anticondensation heating:

in all power part cubicles
in control, excitation cubicles and
cooling unit
as option only

h) Additional specifications of air-cooled version MEGADRIIVE-LCI converters:

- | | |
|--|---|
| Manufacturer | ABB |
| Ambient conditions | |
| - classification of environmental conditions | IEC 721-3-3
3K3/3Z2/3B1/3C1R/3S1/3M1 |
| - air temperature range - operation | 1 ... 50 °C |
| - storage | 0 ... 55 °C |
| - air quality: air must be free of particles as coal, iron, etc. | |
| - air humidity rating (without condensation) | 5% ... 85% |
| - altitude | < 2000 m |



- seismic conditions	on request
Noise level at 1 m distance	≤ 80 dB(A)
Standard	IEC 60146

Power part

The power part of **air-cooled** LCI converters is uses thyristor units of ABB's well established VERITHYR[®] equipment.

The **VERITHYR[®]** units used for both - line and machine - converters, are of identical design and comprise, apart from the thyristors and heat sinks, snubber circuits, gate firing circuits and current and voltage transformers. These units are of fuseless make.

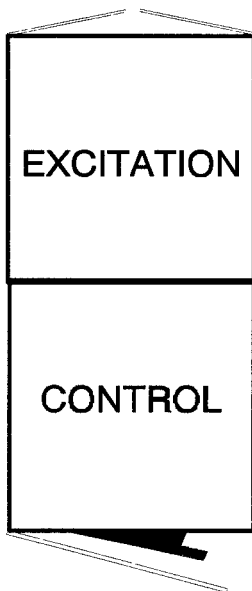
The thyristors and heat sinks are assembled in vertically arranged stacks. The *cooling* is made *by forced* airflow from back to front of the stacks. This means that in the converter cubicles the air passes only through one heat sink, resulting in low air pressure drop.

Fans integrated in the converter cubicle take the air through the front door of the connection cubicle and blow it out through the air grating in the roof of the converter cubicle. The noise level is low because of relatively low air speed.

Due to this design the thyristor units are very compact and they have a minimum of connecting points.

Converter control unit

The complete control system for the water-cooled LCI.DR converter is placed in a two-cubicle arrangement.



These cubicles contain the following functions:

- | | | |
|-----------------------------|------------|---|
| CONTROL - cubicle | - standard | <ul style="list-style-type: none"> - control-terminals and interface units - control and protection in rack - operator's panel on the front door for <ul style="list-style-type: none"> - indication - fault indication - operation - auxiliaries - auxiliary terminals - auxiliaries for control |
| EXCITATION - cubicle | - standard | <ul style="list-style-type: none"> - auxiliary-input terminals and input contactor - breaker, 3-phase AC-power controller and output terminals for excitation without slip-rings - auxiliaries for converters, cooling unit and control |

7. Converter controller

a) PSR2 - the high-speed processing device

Because of high computing capacity of the PSR, all control, regulation, monitoring and protection functions can be performed by a single processing unit, using a function block programming language.

The processor comprises two main units:

- a high-speed processing board, on which a micro-program-controlled RISC (Reduced Instruction Set Computer) with "Extended Harvard Architecture" processes the user program,
- a communication board based on an Intel 80C186 microprocessor with an interface to the parallel multi-processor bus, a coupler for the serial ARCnet bus and a serial interface.

The advantages of the excellent communication facilities for the user are:

- extreme flexibility when loading the user program and loading and viewing data and parameters
- high reliability through extensive self-monitoring
- comprehensive diagnostic and testing facilities for effective user support when testing and commissioning plants.

b) Hardware structure of the PSR system

The digital controller system consists of different plug-in units such as processor unit, interface module and gate control unit, which are linked together by a fast B448 parallel bus. An additional communication processor makes provision for the direct exchange of data with the superimposed control system (optional).

The bus structure replaces the classic interfaces by transparent paths, which offer advantages not only with respect to accuracy and flexibility, but also with respect to the numerous supplementary functions for diagnostic and optimization purposes.

c) Less wiring thanks to ARCnet®

The data exchange within the MEGADRIE-LCI converter takes place via a serial ARCnet bus. This method reduces the wiring between the different



components of the converter and the control cubicle to a minimum. The control and display unit for local operation of the control system is also connected to the ARCnet bus.

d) Simple to operate

The control and display unit is used to control the system, to view actual operating values and to annunciate failures. It comprises

- a LCD display with eight lines and LED background lighting. Selection can be made between alphanumeric and alphanumeric/analogue presentation.
- function keys for controlling the functions of the display and for operating the LCI locally.

The functions of the control and display unit and the setting of the operating parameters are programmed using a Personal Computer (PC).

e) Simple to integrate in superimposed control systems

The input and output modules, which are located as close as possible to the process vicinity, translate the process signals into system-conform binary signals. Binary signals are transferred to and from the interface units via standardized system cables. For distances up to 10 m between the processor and the unit to be controlled, distributed I/O units are connected to an interface module by a parallel bus.

Special interface units can optionally be provided for the exchange of data between the PSR2-system and the superimposed control systems. The following communication protocols may be used:

- Allen-Bradley PLC 2
- Modbus
- ABB master Fieldbus

Mode of operation

Reference values and measured values from the process are transferred continuously and cyclically to the input memory of the I/O module. The processing unit has free access to this memory via the high-performance multiprocessor bus B4482 and transfers its calculated control values into the output memory of the I/O module.

From there they are transmitted also continuously and cyclically to the power control devices in order to act upon the process.

The scanning (i.e. sample) elements of the input modules can be controlled such that a certain number of pre-selected values can be simultaneously sampled and held.



Multiprocessor bus

The internal bus of the PSR system is a high-performance parallel bus for multiprocessing operation.

Each of the processing units working in parallel has free access to all input/output modules. The bus has no central bus coordinator. Arbitrages located in the bus interface of each processing unit decides in a democratic way which processing unit has free access to the bus.

Self-Checking, Diagnostic

The PSR system has extended self-test facilities. Four different categories can be classified

- self-test of the hardware modules (supply voltages, input- output channels and so on)
- self-test of the user program sequence
- self-test of the data and address transmission on the PSR system bus (timing and parity checks)
- automatic and programmable test routines

Malfunctions are indicated by one to three LED's and by individual electronic signals on each module.

Adaptations during tests, commissioning and operation

With PSR control, all the parameters and the structure of the user program e.g.

- open- and closed-loop control
 - monitoring and protection (1st stage)
- can easily be adapted to altered conditions.

Parameters can be changed optional on-line, the structure has to be changed off-line.



8. Sequence control

Binary inputs (BI): (positive pulses >100 ms)	AUX-ON AUX-OFF DRIVE-ON DRIVE-OFF	
Binary outputs (BO): (continuous signals)	AUX-READY AUX-ARE-ON AUX-ARE-OFF BREAK-READY DRIVE-READY DRIVE-IS-ON DRIVE-IS-OFF MOTOR-IS-ROTATING OPERATION-REMOTE/*LOCAL COMMON-ALARM COMMON-TRIP	(ready to be switched on) (ready to be switched on) (ready to be switched on)
Analogue inputs (AI):	SPEED SET VALUE	
Analogue outputs (AO):	SPEED ACTUAL VALUE	

The standard interface signals with the main switchgear are:

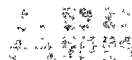
Binary inputs:	CIRC-BREAK-TRIPPING
Binary outputs:	CIRC-BREAK-EMERG-OFF

The standard signal interchange between the drive system and the customers remote control system is a parallel signal interface with the following technical data:

- analogue input and output signals (0) 4 ... 20 mA dc.
- binary inputs are realized as contact status inputs with:
 - input voltage 24 ... 250 V dc. (+20/-25%)
 - input current 6 ... 8 mA
- binary output signals are realized by relay changeover contacts with:
 - max. switching voltage 250 V ac. or dc.
 - max. switching current 5 A
 - max. switching power 2000 VA

b) The start-sequence includes the following steps:

Input signal	Remarks	Output signal
	<p>In the converter, all MCBs have to be closed. All auxiliary power supplies have to be switched on - first the "3-phase AUX. power supply" - then the "control system power supply":</p> <p>As soon as the converter control detects that the "3-phase AUX. power supply" has been switched on (the monitoring "AUX AC undervoltage " disappears) and if no failures are monitored:</p>	<p>DRIVE-READY = 0 DRIVE-IS-OFF = 1 DRIVE-IS-ON = 0 MOTOR-IS-ROT. = 0</p> <p>DRIVE-READY = 1</p>
	Begin of start sequence	
DRIVE-ON	<p>The signal "DRIVE-READY" permits the remote control to close the main breaker and to start the drive.</p> <p>The converter control releases the pulses and builds up the currents in the excitation, line and machine converters:</p> <p>As soon as the actual speed is higher than a presettable threshold value The motor accelerates up to the speed set value</p>	<p>DRIVE-IS-ON = 1 DRIVE-IS-OFF = 0 DRIVE-READY = 0 MOTOR-IS-ROT. = 1</p>
	End of start-sequence	
	Speed control of the motor via the analogue input "SPEED SET VALUE"	



c) The stop-sequence includes the following steps:

Input signal	Remarks	Output signal
	Speed control of the motor	DRIVE-IS-ON = 1 DRIVE-READY = 0 MOTOR-IS-ROT. = 1
	Begin of stop sequence	
DRIVE-OFF	a) <i>coasting</i> (standard): The converter control reduces the currents to zero and blocks the pulses in the line, machine and excitation converters; the motor coasts down to speed zero. As soon as the actual speed is lower than a presettable threshold value:	DRIVE-IS-OFF = 1 DRIVE-IS-ON = 0 DRIVE-READY = 1 MOTOR-IS-ROT. = 0
	b) <i>electrical breaking</i> (option): The converter changes the direction of the energy flow to generating operation (by controlling the machine converter as rectifier and the line converter as inverter). The motor is decelerated. As soon as the actual speed is lower than a presettable threshold value, the converters are switched off.	MOTOR-IS-ROT. = 0 DRIVE-IS-OFF = 1 DRIVE-IS-ON = 0 DRIVE-READY = 1
	End of stop-sequence	
	The signal "DRIVE-IS-OFF" permits the remote control to open the main breaker and to switch off the auxiliary power supply of the converter..	

Regulation (see Fig. 3a and Fig. 3b)

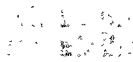
If losses and the influence of flux and current harmonics are disregarded, the synchronous motor develops a torque which can be determined by the formula

$$T_M = K \times i_d \times \frac{u_m}{\omega} \times \cos \phi_m$$

Where:

T_M	=	Average torque
K	=	Constant
i_d	=	Average current in DC link
u_m	=	Voltages at terminals of synchronous motor
ω	=	Angular velocity of synchronous motor = speed
ϕ_m	=	Phase difference between fundamentals of current and voltage at terminals of synchronous motor

The machine flux u_m/ω and power factor $\cos \phi_m$ are given values which result in a frequency changer of optimum size and design; that means a value close to 1.0 is taken for $\cos \phi_m$, while the nominal flux is taken as value of u_m/ω . The magnitude of the torque is determined by the



chosen value of direct current i_d , and the torque direction by the sign selected for the power factor $\cos \phi_m$.

Speed control

The speed controller with the inner current control loop is a classic cascade feedback arrangement. On normal operation conditions a speed control accuracy of 0,5 % of nominal speed can be reached.

Current control

Current i_d is regulated by a control loop acting on the line converter. The set value " i_{dw} " is provided by the speed controller or limiters. Such limits are matched to the load capacity of the converter.

Machine flux control

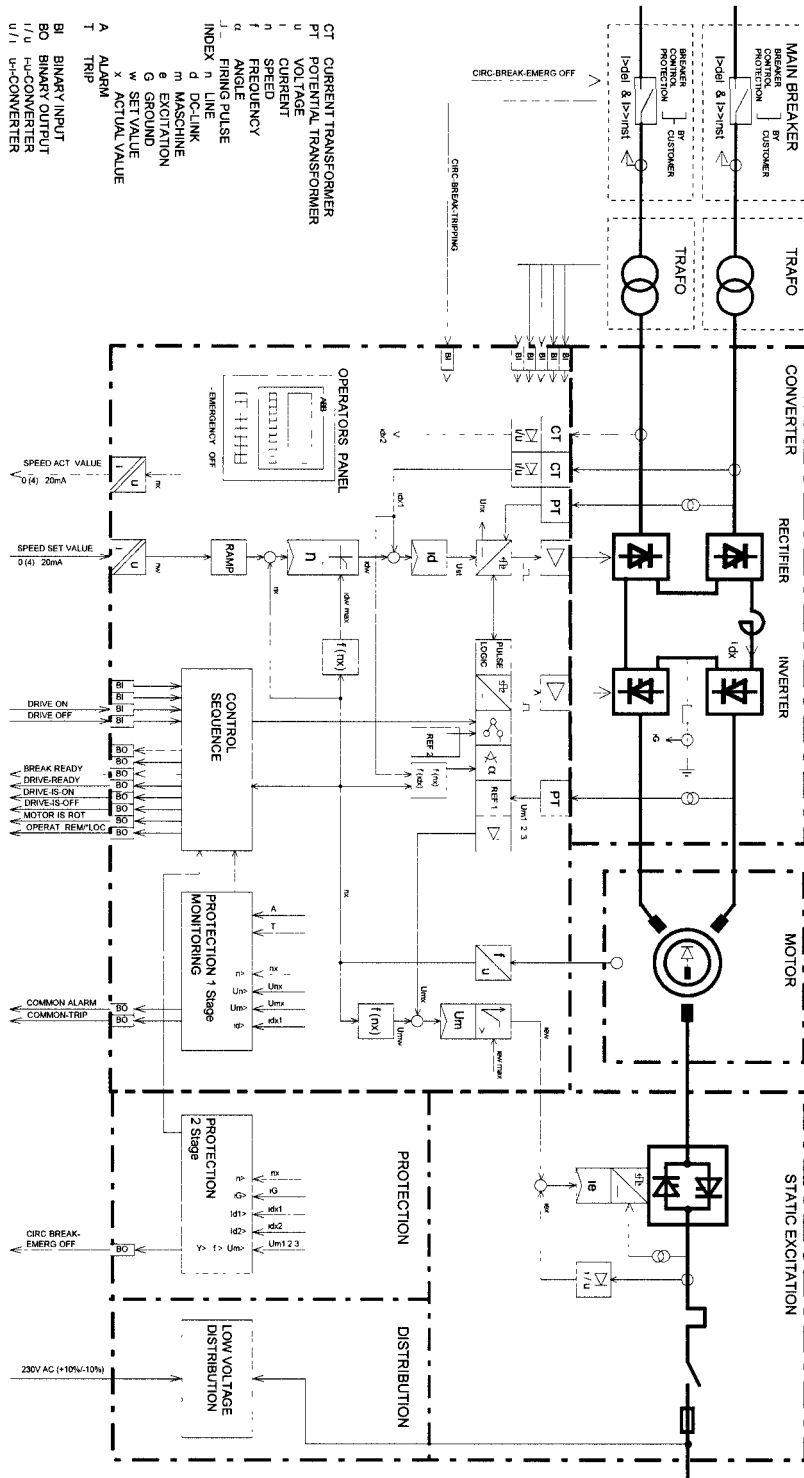
The machine voltage " u_m " is regulated by a separate control loop acting on the excitation converter. The set value " u_{mw} " varies proportionally to the speed actual value n_x in such a way that the machine flux is held at its nominal value.

Power factor $\cos \phi_m$ control

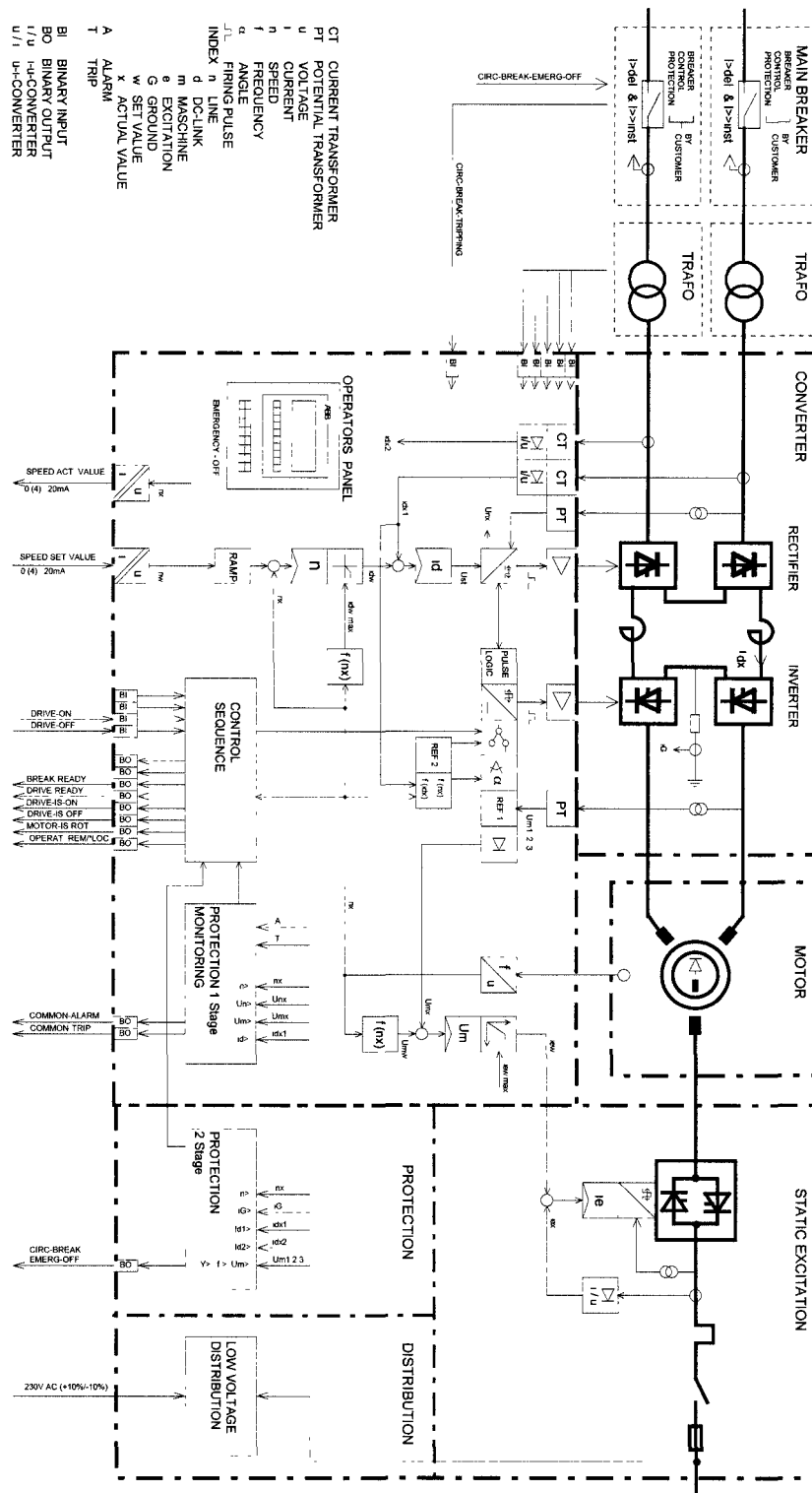
The firing angle for the machine converter has to be chosen so as to obtain the best possible utilisation of frequency changer and machine. This is the case when current and voltage are in phase. Power factor is then unity. However, this is possible only in pulse mode operation. For load-commutation (over about 10 % of rated speed) the power factor is restricted to approximately - 0,85 owing to the commutation angle and the minimum extinction angle.

The gate control unit of the machine converter is designed for variable frequency and variable voltage. The machine voltages are used as reference voltages for the thyristor firing sequence.

Standard Cabinet Single Line Diagram - Item 100



Split Cabinet Single Line Diagram - Item 110





9. Protection and Monitoring

The standard protection and monitoring functions in LCI.DR converters are realized as follows:

Protection 1st stage alarms and trips are monitored and memorized (with first and new value signalling) in the programmable high speed controller PSR and indicated on the operators panel.

The signal COMMON-ALARM is sent

- to an output relay as information for the remote control.
- to the converter control operator's panel.

If an alarm occurs

- in operation, the drive is not switched off.
- at standstill, the drive is not prevented from starting.

The signal COMMON-TRIP is sent

- to an output relay as information for the remote control to switch off the drive (converter and main breaker).
- to the internal sequence control to initiate an orderly stop sequence.
- to the converter control operator's panel.
- to an output relay which activates the (normally energized) interposing relay CIRC-BREAK-EMERGENCY-OFF as order to trip the main breaker immediately.

Protection 2nd stage trips are monitored and memorized in conventional, hardwired protection units that are independent of the PSR (backup to PSR).

The common signal PROTECTION TRIP is sent

- to an output relay which activates the (normally energized) interposing relay CIRC-BREAK-EMERGENCY-OFF as order to trip the main breaker immediately.
- immediately to the line-side gate-control units to shift the pulses to the inverter limit.
- delayed to the gate control units and the pulse amplifiers to block the pulses.
- to the protection 1st stage.

a) Protection 1st stage alarms (A) and trips (T) are:

Main breaker

- protection	circuit breaker is tripping		T	
--------------	-----------------------------	--	---	--

Transformer

- see transformer spec.				
-------------------------	--	--	--	--

Converter

- power part	line and motor surge arrester fuses		A	1)
	line overvoltage	un>; <1 sec	A	
		un>; >1 sec	T	
	line undervoltage	un<; <1 sec	A	
		un<; >1 sec	T	
	converter 1 overcurrent	id1>	T	
	converter 2 overcurrent	id2>	T	2)
	Converter currents not identical	id1≠id2	T	2)
	motor undervoltage/underflux	um<	A	
	motor overvoltage/overflux	um>	T	
- converter cooling	door contacts		T	
	MCB's of PT's in power part		T	
- converter control	air pressure low	<<	T	
- converter control	control electronic failure		A	
	on sequence time supervision	T>	T	
	protection units in test		A	
	protection trip (from 2nd stage protection)		T	
	motor overfrequency/overspeed	f>; n>	T	
- auxiliaries	emergency push-button		T	
	3-phase AUX undervoltage	AUX<; <1 sec	A	
		AUX<; >1 sec	T	
- excitation	MCB protection circuit open		A/T	
	excitation protection circuit open		T	
	excitation breaker fault		T	
	excitation fan air flow low (if available)		T	

Motor

- see motor spec.				
-------------------	--	--	--	--

1) start with faulty fuse is not possible

2) only with converters in "two-channel 12/12 pulse connection" (2*06 types)



b) Protection 2nd stage trips (T) are:

Protection unit	Protection function		action	Signal to protection 1st stage
PCB CS A463	- ground fault current	IG>	T	- protection trip
	- ground fault current 2	iG2>	T	
	- converter 1 overcurrent	id1>	T	
	- converter 2 overcurrent	id2>	T	
	- motor overspeed	n>	T	
	- converter currents not identical	id1≠id2		
PCB CS A464	- motor overvoltage	um>	T	
	- motor overflux	ψ>	T	
	- motor overfrequency	f>	T	
push button	- emergency trip		T	- emergency push-button

1) only with converters in "two-channel 12/12 pulse connection" (...2*06 types)

2) only for applications with speed-sensor

c) Remarks to protection signals:

- Circuit breaker is tripping (binary input signal "CIRC-BREAK-TRIPPING")
This signal must be generated in the circuit breaker; it indicates to the converter protection that the circuit breaker protection requests the breaker to trip. The converter control reduces the converter current to zero immediately (within ca. 20 ms). The circuit breaker contacts open only >40...50 ms (the breaker opening time) after the trip request, that means when the breaker current is already zero.
- Line overvoltage protection
The line voltage is monitored:
 - if the voltage increases above 110%, the converter current will be immediately reduced to zero and the motor will coast down; indication: alarm "line overvoltage".
 - if the voltage drops within 1 sec below 110%, the converter current will be built up again (flying start) and the motor will re-accelerate to the speed set value. Such a voltage-peak ride through is however only possible if the control electronic has an uninterruptable power supply.
 - if the voltage stays above 110% for longer than 1 sec, the converter will be tripped and the motor will continue to coast down; indication: trip "line overvoltage".
- Line undervoltage protection
The line voltage is monitored:
 - if the voltage drops below 85%, the converter current will be immediately reduced to zero and the motor will coast down; indication: alarm "line undervoltage".
 - if the voltage recovers within 1 sec above 85%, the converter current will be built up again (flying start) and the motor will re-accelerate to the speed set value. Such a voltage-dip ride through is however only possible if the control electronic has an uninterruptable power supply.
 - if the voltage stays below 85% for longer than 1 sec, the converter will be tripped and the motor will continue to coast down; indication: trip "line undervoltage".



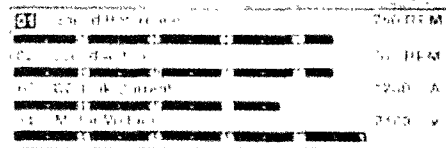
- 3-phase AUX power supply undervoltage protection
The auxiliary power supply is monitored:
 - if the voltage drops below 85%, the converter currents will be immediately reduced to zero and the motor will coast down; indication: alarm "3-phase AUX undervoltage".
 - if the voltage recovers within 1 sec above 85%, the converter currents will be built up again (flying start) and the motor will re-accelerate to the speed set value. Such a voltage-dip ride through is however only possible if the control electronic has an uninterruptable power supply.
 - if the voltage stays longer than 1 sec below 85%, the converters will be tripped and the motor will continue to coast down; indication: trip "3-phase AUX undervoltage".
- Field exciter protection
The motor excitation generally is monitored by measuring the motor voltage and comparing it with its set value.
- Control electronic monitoring
Each PCB monitors (as well as possible) its functional availability (indication with a red "Fault LED" or a green "ok LED" on the PCB).
- MCB-supervision
Supervision that all MCBs (miniature circuit breakers) are closed.

10.Operator's panel

a) Control panel (display for monitoring and system information)

The control panel contains the following functions:

- display with 8 lines, each 39 characters (240*64 dots) to indicate:
 - 8 (of max. 152) error messages with their error number and descriptions (with first failure in first line), or
 - 8 (of max. 64) analogue values with channel number, signal name, value and physical unit, or
 - 4 analogue values with channel number, signal name, value, physical unit and an analogue bar display of 0 to 120%.
- 10 control keys for controlling the operation mode and the functions of the panel
- 16 control keys with LEDs for controlling drive specific functions (on, off, higher, lower, ...).



b) Additional operation elements

- | | |
|-----------------------|---------------------------|
| - indicating lamps | - common alarm |
| | - common trip |
| - running-hour meters | - motor |
| | - control electronic |
| - push button | - emergency trip |
| - key switch | - local / remote selector |



c) Local / remote control

In normal operation, the drive system is controlled via the customers remote control system; for commissioning and service work, local operation from the control panel on the converter control cubicle is possible (auxiliaries on/off; drive on/off; speed set value higher/lower; ...).

The changeover from remote to local operation and vice versa can be done at any time.

Remarks:

- In remote operation, the motor speed follows the external speed set value.
- In local operation, the motor speed follows the local speed set value (set with the function keys on the control panel).
- After a changeover, the speed set value changes with the preset speed-ramp from the remote set value to the local set value.



11.Auxiliaries and distribution

a) Low-voltage supply

The frequency converter needs the following auxiliary supply low-voltages:

- 3-phase AUX power supply for field excitation, fans/pumps and other auxiliary equipment:

- voltage	3~ 400 V (+10/-10%)	
- frequency	50 Hz (+5/-5%)	
- consumption consist of:	nominal speed (continuous)	start up (short time)
- auxiliaries	2 kVA	2 kVA
- water pump power	see cooling unit	see cooling unit
- excitation power	see excitation	see excitation

- Control power supply from UPS (uninterruptable power supply) for control electronics:

- voltage	1 x 230 V (+10/-10%) from UPS
- frequency	50 Hz (+5/-5%)
- consumption ca.	1.5 kVA

b) Low-voltage distribution

On the incoming and in the low-voltage distribution, load switches with fuses and MCB's (miniature circuit breakers) are used.



12.Excitation

The excitation system contains the following components:

- a three phase ac contactor to switch on and off the excitation supply voltage
- overcurrent protecting devices
 - line fuses
 - thermal overcurrent relay
- the 3-phase ac power controller to control the excitation power; it includes the following parts:
 - six thyristors in anti-parallel 3-phase connection with snubber circuits
 - transient overvoltage circuits
 - current transformers and electronic control equipment for exciter-current control
 - power supply for the control equipment
- Technical data:

- AC voltage	3 x 400 V
- AC current	≤ 300 A
- AC power at start up (short time)	≤ 207 kVA
- AC power at nominal speed (continuous)	≤ kVA (see motor specification)

The excitation system is controlled and monitored through the converter control.

13. Drawings

Documentation SFC		
Document No.	Title	
TBD	Drawing list	
will follow	Dimension Drawing	
will follow	Main Cable Connection Drawing	
will follow	List of Recomm. Spares	
will follow	Design Data	
will follow	Start Up Characteristic	
will follow	Flow Chart	
will follow	Hardware Diagram	
will follow	Interface Diagram	
will follow	Supplementary Outfit	
will follow	Software Diagram	
will follow	LCI.ST Commission. Procedure	
will follow	Inspection and Test Plan	
will follow	Engineering and Production Program	
	User's Manuals	

14. Turning Gear Operation

(ABB control description see "Detailed Description LCI.pdf")

adjust the speed set value to any value between 10% and 100% speed (specified in F7-9); the actual speed will be adjusted through the control to the speed set value; the control loops are described in "Detailed Description LCI.pdf, page 11&12.

Inverter commutation and control principle from 10% to 100% speed: the inverter is "machine commutated" and the inverter is "controlled direct from motor voltages" (see "Detailed Description LCI.pdf, page 7)